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ADDRESS OF THE PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES[1]

By Dr. W. W. CAMPBELL

LICK OBSERVATORY
UNIVERSITY OF CALIFORNIA

THE committee on the program for the meeting of the academy has requested me to continue this evening the series of president's addresses inaugurated two years ago. This I gladly do, as there are several matters which could wisely be spoken of on this occasion; but the need for brevity on my part is made clear by the fact that several medals and prizes are to be awarded after the close of this address.

At our dinner of last year I spoke at length, and I hope with some evidence of deep feeling, about the threatened reduction of financial support for research activities in all our universities, research institutions, learned societies and the research bureaus of the United States Government, and about the resulting state of anxiety on that subject then existing with the members of the faculties and staffs of those organizations. The threatened reductions were made, by essentially all the organizations referred to, and in most cases upon a heroic scale. Clearly there is no need for me to speak again, or at this time, concerning adequate support for research in the domain of the sciences by our government, as the many paragraphs on that subject in my address of one year ago were published in the journal SCIENCE, through the courtesy of Editor Cattell, and for the further reason that in the twelve intervening months the evidences of interest in scientific research within the borders of our country, and likewise in the question of international

[1] Given after the dinner at the annual meeting of the academy, April 24.

cooperation in research, have been plainly visible in many high governmental places; but I doubt whether the dread fears of yet greater reductions of research support in the universities, more especially in the state universities, and in many other research institutions, have been allayed. Notwithstanding the heavy subtractions from research support, the output of scientific development and discovery has continued to be fine in quality and surprisingly large in quantity, but the time has not yet come when we can estimate the full consequences of the reductions. If the support should continue upon the reduced scale through two or three additional years, extremely unfortunate effects could scarcely be avoided. Especially do we view with regret the inability of many instructors, research assistants, and recent recipients of the doctor of philosophy degree to do those things which they had enthusiastically and successfully prepared themselves to do, at the cost of much time, money and energy. A few years of temporizing with odd jobs to secure a living for themselves and their dependents will go far in breaking their scholarly spirit and their high ambitions, and take them permanently out of the research field, with great resulting harm, not only to themselves, but to the public welfare. These sympathetic and anxious views I express after making due allowance for the conditions, well known to our members, that too many unworthy students are permitted to go through our colleges, that too many doctorate degrees are conferred by our universities, and that some activities labeled research are not entitled to bear that name.

I am not called upon to declare here, of all places in the United States, and especially before this audience, the importance of research, the incomparable values of its accomplishments, the need for its continuance in strength diminished in no greater degree than is unavoidable and essential to the public weal. I venture to say you will join me in expressing the opinion that the products of research in the domain of the physical and biological sciences, including the medical sciences, have been more potent in advancing the state of civilization on the earth from its low level of the fifteenth and earlier centuries to its at least decidedly higher level in the twentieth century than have all other forces combined. I do not question the thesis that many forces of non-scientific character, both idealistic and practical, have been exceedingly influential and powerful in behalf of the nations and their peoples, but in the main those forces would not have existed, or certainly could not have operated, if the sciences had not provided the mental and moral attitudes, the open sesame that permitted those forces to go out into the great world and exert their effective and beneficient influences.

In his Henry VI Shakespeare says, "Ill blows the wind that profits nobody." In Henry IV and possibly elsewhere he repeats the sentiment. Quite likely Shakespeare found it in the writings of earlier authors or observed it to be in current use. This sentiment has lived through the centuries, because it represents human experience. I hope you will not regard me as unsympathetic when I predict that some good, some profit, will come out of the lamentable economic winds of the past four years. The sufferings of many millions of our people, now receiving the profound consideration of our governments and of our fellow citizens, as to corrective measures for the present, and preventive measures for the future, will, I hope, be short-term sufferings; the benefits will, I believe, be long-term benefits. The stupendous bills we have been paying for our various acts of foolishness in financial and other fields may be regarded, in my humble opinion, as educational bills; and the costs of educating a nation are always high.

Going back in time no further than 1921, it has been as if the idealism with which we did our part in the war had changed, with startling rapidity, to precisely the opposite quality—materialism; as if we had "fallen ill of a fever"—the fever of speculation; the fever of greed; the fever that too frequently urged the getting of material things, especially money, in return for little or no real service. If, as the sequel, we are persuaded to stop and consider what things are worth living for, and to reach the conclusion which clearly accords with the truth—namely, that the real progress of the world depends upon ideals and idealistic possessions and not upon material things—the immense cost and waste will in some measure have been balanced.

Amongst the many good things already brought by the recent winds of adversity which should be of special interest to us, because of the dependence of research, in the long run, upon the standards prevailing in the colleges and universities, are, in my opinion, the following:

(1) The wider recognition of the principle that, as the laws of our nation and of the several states do not require even one young man, or any young man, to go to college, every college student should assume the duty and responsibility of deciding for himself whether or not he is going to study seriously the subjects of his choice, without any prodding or coddling by his institution, and abide by the consequences. We hear it said on the college campuses that the development of character in the students is a more important objective than the development of scholarly ambition. I am not disposed to quarrel with that thesis; in fact, I accept it; but I have yet to be convinced that a strong and worth-while type of character will in any

degree whatsoever result from putting unambitious students through college by either the prodding or the coddling process. Personal responsibility, assumed and discharged, is the greatest of all teachers and the best developer of character. The chill economic winds of the past four years have, indirectly, in my opinion, already raised the level of scholarship in our colleges, with additions to, rather than subtractions from, the personal-character yield.

(2) A realization by our college and university students that in the filling of a position offering fine opportunities for the higher teaching, or for research, we have now for the first time reached the condition of very real competition of many applicants for the position, and that in strong measure this condition is likely to remain with us indefinitely. Competition makes for greater effort and better results, and its persuasive effects upon young men in universities now preparing for high places are said to be apparent.

(3) A growing realization by our thoughtful citizens and over-burdened taxpayers that there is pressing need for greater utilization of scientific advice and scientific planning in the governmental affairs of the nation, the states, the counties and the municipalities, as evidenced by the calling upon many professors and investigators in the several sciences in various parts of the nation for guidance and assistance.

Members of the academy, we can not be reminded too frequently of the academy's mode of origin and of the academy's one purpose, as expressed by its founders. At a time of great national stress and strain, in the middle year of the Civil War, 1863, the Congress of the United States, desiring to have a definite organization of men learned and experienced in the physical and biological sciences to which it could go for knowledge and advice on scientific subjects, gave charter to such an organization, through the adoption of an *Act to Incorporate the National Academy of Sciences,* and to said act President Lincoln attached his signature in approval. The one and only purpose of the academy in the eyes of the Congress was that it should be the adviser of the government in scientific matters, as expressed in the charter, thus: ". . . the Academy shall, whenever called upon by any Department of the Government, investigate, examine, experiment, and report upon any subject in science or art [meaning not the esthetic arts, but the practical arts] . . . , but the Academy shall receive no compensation whatever for any services to the Government of the United States."

When an American citizen, necessarily a contributor to knowledge, accepts election to membership in the academy, he tacitly agrees to heed every such summons, and to serve his government to the best of his ability, in the manner described, without expectation of receiving compensation. In the seventy-one years of its life, the academy has responded many times to the government's call, on the terms prescribed in the charter, and gladly.

In this connection you will be interested in a quotation from the splendid annual address delivered by the distinguished President of the Royal Society, Sir William Huggins, at the society's anniversary meeting, in 1904: "During the last few years a very large amount . . . of work outside the reading, discussion, and printing of papers . . . has been thrown upon the Royal Society. . . . . . mainly it has consisted of assistance freely given, at their request, to different Departments of the Government on questions which require expert scientific knowledge, and which involve no small amount of labor of the officers and staff, and much free sacrifice of time and energy from Fellows, ..."

The charter condition, "that the Academy shall receive no compensation whatever for any services to the Government of the United States," exemplifies the correct and only wise policy. The academy, in providing knowledge and in giving advice, must be wholly disinterested, in the financial or material sense. The academy is interested in the truth, in its origins and causes and, especially when giving advice, in the consequences of the truth; and it must not compromise with expediency.

The comments of the president of the Royal Society, Sir William Huggins, in the same annual address, upon this item of policy, are very interesting. The Royal Society "asks for no endowment from the State, for it could not tolerate the control from without which follows the acceptance of public money, nor permit of that interference with its internal affairs which . . . is associated with State endowment." Again, from the same address, ". . . the Royal Society . . . has been regarded by the Government as the acknowledged national scientific body, whose advice is of the highest authority on all scientific questions, and the more to be trusted on account of the Society's financial independence"; and, quoting further, "The financial independence of the Royal Society, neither receiving nor wishing to accept State aid for its own private purpose, has enabled the Society to give advice and assistance which, both with the Government and with Parliament, have the weight and finality of a wholly disinterested opinion."

This beautiful and interesting building, the home of the academy, was completed and occupied just ten years ago. Previously, and during the first sixty-one years of its life, the academy had no home it could call its own. Administrative headquarters and rooms and other facilities for the successive April meetings

were most generously made available by the secretary and regents of the Smithsonian Institution. The long delay in securing an abiding place had one valued advantage: the legal title to this building and to its grounds rests with the National Academy of Sciences: the land was provided by gifts to the academy made by many public-spirited citizens; and the building, and an endowment fund to cover the costs of the building's maintenance and administration for the use of the National Academy of Sciences and the National Research Council, were the exceedingly generous gift of the Carnegie Corporation.

There are some unfortunate consequences of the long delay in finding a permanent home. Ever since 1863, countless publications on scientific subjects have been coming to the academy, by gift and exchange. There are many tens of thousands of books, pamphlets, journals, et cetera, in the large basement room that was planned and constructed to receive book shelves, and there are the Library Room (where we met before dinner), fitted to receive six or seven thousand volumes most in demand, and the beautiful Reading Room to the west of the Library Room; but until two days ago there had been no positive and material action taken to provide a working library, or even an orderly arrangement of the books. A little over a year ago I appointed a committee to study and consider our library problem, and to formulate a definite library policy, under the able chairmanship of Dr. David White, for recommendation to the academy's council; and some very desirable decisions concerning a library policy have this week been made.

Secondly, the walls of our rooms are in the main bare and monotonous. We have no portraits, busts, tablets or other works of art in commemoration of our deceased members. Those of us who have been privileged to visit the rooms of the Royal Society, of the colleges in Oxford and Cambridge, and of similar institutions in Great Britain and on the European continent, know how vitally such memorials contribute to the attractiveness and the spiritual effectiveness of those institutions. In recent months the council of the academy has considered this subject, in relation to the academy's rooms, and a committee is in process of appointment, with duty to formulate a policy for submission to the council.

The academy has been exceedingly fortunate, uniquely fortunate, in view of its comparative youth, in its receipt of gifts and bequests to serve as foundations for the awarding of medals and prizes of money, and the making of grants in aid of research. We have nine medal funds, not counting the Barnard Gold Medal [for which a committee of the academy selects the recipient for recommendation to Columbia University in New York, the university making the actual award once in five years, in recognition of meritorious services to science]. Six of the academy's medals and likewise the Barnard Medal bear the honored names of deceased academy members; and eight foundations providing grants for aid in research projects also bear the names of deceased members. For these valued provisions the academy is deeply grateful. The awards and grants are made in recognition of noteworthy accomplishments in research, and for the encouragement of research activity and discovery in the future. More briefly they are to be interpreted as honors conferred by the National Academy of Sciences upon their receipients, but in this connection I should like to repeat a statement in my address of two years ago: the academy's ability to confer honor upon its members and others of high achievement proceeds from the honors conferred upon the academy by its members through their accomplishments in the advancement of knowledge.

In the current academic year the academy is awarding five medals and four honoraria. The first of these awards, the Comstock Prize in money, was formally presented to Professor Percy Williams Bridgman, of Harvard University, at the meeting of last November in Cambridge. You may be interested to know that the amount recorded on the certified check drawn to Professor Bridgman's order was $2,500.00.

There are five medals and three prizes to be presented this evening. The need for short presentation addresses and short responses is apparent.

The Committee on the Marcellus Hartley Gold Medal, for eminence in the application of science to the public welfare, has recommended that the medal for 1934 be awarded to Dr. David Fairchild, from 1889 until his retirement two or three years ago an invaluable member and officer of the scientific staff of the Department of Agriculture, and the academy has formally confirmed the recommendation. To our extreme regret the eminent recipient of the award, Dr. Fairchild, is in a state of ill health that requires him to live in Florida during the winter and early spring months, and his desire to be with us and receive the medal in person has been denied by his physician. The medal will be received by Dr. Fairchild's representative for the occasion, Mr. Knowles A. Ryerson, chief of the Bureau of Plant Industry in the Department of Agriculture, who will respond in Dr. Fairchild's name. Chairman Gano Dunn of the committee has likewise been prevented by illness of several months' duration from making the presentation address, but his colleague on the committee, Dr. H. H. Donaldson, member of the Wistar Institute of Anatomy and Biology, will state the reasons that governed the choice of Dr. Fairchild for the award.

There are two Daniel Giraud Elliot Medals and Honoraria to be presented this evening, for most meritorious work in zoology or paleontology pub-

lished each year. The condition fixed by the donor, "published each year," has had the practical effect of delaying the successive awards.

The Committee on the Daniel Giraud Elliot Fund has recommended that the Gold Medal and the Honorarium for the year 1930 be awarded to Professor George Ellett Coghill, member of the Wistar Institute of Anatomy and Biology, and the academy has been pleased to confirm the recommendation. We are grateful for the presence of Professor Coghill and Mrs. Coghill as the guests of the academy. Dr. Ross G. Harrison, Sterling professor of biology in Yale University, chairman of the academy's committee, will state the reasons that governed the committee's selection of Professor Coghill.

The second of the two awards, that for the year 1931, carries with it a note of sadness. Last autumn the Committee on the Daniel Giraud Elliot Medal and Honorarium recommended that the award for 1931 be made to Dr. Davidson Black, a citizen of Canada, fellow of the Royal Society, fellow of the Royal Society of Canada, and professor in the Peiping Union Medical School, Peiping, China; and to the committee's recommendation the academy was pleased to give its approval. I regret exceedingly to say that six weeks ago occurred in Peiping the lamented and untimely death of Dr. Black. Fortunately, Professor Black last November received the academy's official notification of the award and the academy's invitation to be with us this evening. He responded in appreciation of the honor done him, but said, with regret, that the great distance would prevent him from coming. It is in accordance with the academy's custom that the award be made posthumously. The address in recital of the reasons leading to the choice of Professor Black will be made by Professor Henry Fairfield Osborn, a member of the committee. Through the kind offices of the Envoy and Minister of Canada, I sought for the name and address of a near family relation of the late Dr. Black who could attend our dinner as the academy's guest and receive the Medal and Honorarium, but this proved to be not practicable. We are fortunate that our esteemed foreign associate, Professor Frank Dawson Adams, of McGill University, Montreal, fellow of the Royal Society and fellow of the Royal Society of Canada, is here to serve as Mrs. Black's representative. Professor Osborn will speak of the late Professor Black's splendid credentials.

Another distinguished foreign associate of the National Academy of Sciences, Sir Arthur Stanley Eddington, of Cambridge University, who is lecturing for a time in Cornell University, is with us to-day, not only in response to my invitation, but in his own constitutional right, as the guest of the academy. He contributed a valued paper to this evening's program, and he is honoring my request that he speak this evening. I do not know the title of his address, but that is no cause for regret, for there lives no devotee of the physical sciences who is more able and successful in making clear his thoughts on any subject of which he speaks or writes. I take unusual pleasure in the privilege of introducing Sir Arthur Stanley Eddington, fellow of the Royal Society, fellow of Trinity College and Plumian professor of astronomy in the University of Cambridge.

We have the valued privilege of making this year the first award and presentation of the Charles Doolittle Walcott Medal and Honorarium. The financial foundation upon which the awards are to be made, once in five years, was generously provided by Mrs. Charles Doolittle Walcott, in memory and honor of her distinguished husband, the late Charles Doolittle Walcott. "The purpose of the fund is to encourage and reward individual achievement in advancing our knowledge of pre-Cambrian life and its history in any part of the world." Dr. Walcott, very able president of the National Academy of Sciences in the years 1917 to 1923, will be remembered also as the splendidly successful director of the U. S. Geological Survey through the years 1894–1907, and secretary of the Smithsonian Institution during twenty years and until the close of his life in 1927, and as a front-rank student of geology and paleontology. Unfortunately, the passing of time prevents me from saying more, except that Mrs. Walcott is with us this evening as the very welcome guest of the academy. The committee on the Charles Doolittle Walcott Medal and Honorarium [$1,350.00], of which Dr. Charles Schuchert, professor emeritus of paleontology in Yale University, is the chairman, has recommended that the first award be made to our likable and wholly admirable fellow member, Dr. David White. Professor Schuchert will state the reasons governing the committee's choice and the academy's decision.

The Agassiz Medal Foundation is an especially interesting one. It was established by gift of the late Sir John Murray, one of the most eminent oceanographers of the British Empire and of the world, in honor of Alexander Agassiz, president of the National Academy of Sciences in the years 1901 to 1907, who, during his lifetime, was a most active and successful student of oceanography and a very liberal patron of oceanographic research. The committee on the medal, of which Professor H. B. Bigelow, director of the Woods Hole Oceanographic Institution, is chairman, has recommended that the medal be awarded to Dr. Björn Helland-Hansen, member of the staff of the Oceanographic Institute at Bergen, Norway; and to this recommendation the academy has gladly given its approval. Dr. Helland-Hansen has found himself unable, by virtue of dis-

tance, and to his extreme regret, to be with us, but we are honored in the presence of the esteemed Envoy and Minister of Norway, in Washington, and Madame Bachke, as the guests of the academy. The minister has graciously consented to serve as the representative of his distinguished countryman, the Agassiz Medalist for the year 1934. I shall ask Professor Bigelow to set forth the reasons governing the award.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE BERKELEY MEETING

Edited by Dr. HENRY B. WARD
PERMANENT SECRETARY

THE ninety-fourth meeting of the association will be held in Berkeley, Calif., from June 18 to 23, 1934. This will be the fourth summer meeting of the association on the Pacific Coast, previous meetings having been held at San Francisco in 1915, at Portland, Oregon, in 1925 and at Pasadena in 1931. All these have been joint meetings with the Pacific Division. This year the University of California and the Pacific Division of the association are cooperating as hosts. Sessions will be held for the most part in lecture halls of the University of California on the campus at Berkeley. As has been found desirable in summer meetings, symposia and invited programs are emphasized and field trips are numerous.

The fine program secured by the efforts of the Pacific Division and the local committee, the attractive environment of the region and the preliminary correspondence regarding attendance all indicate a most successful meeting. It is hoped that a representative attendance from the membership in other sections of the country will take advantage of this opportunity.

LOCAL COMMITTEE, OFFICERS OF SECTIONS AND COOPERATING ORGANIZATIONS

The general chairman of the local committee is Roy Elwood Clausen, professor of genetics at the University of California; the general secretary is Alva Raymond Davis, professor of plant physiology at the University of California; and the treasurer is L. A. Nichols. More than fifty others have been working with these officers as members of subcommittees to provide in various ways for the convenience and comfort of visitors and to make the occasion a conspicuous success. The following sections with the officers indicated have arranged the particular programs and the facilities for the meetings of the sections and the associated societies meeting in Berkeley at this time.

In Mathematics Professor E. R. Hedrick is secretary and Professor T. M. Putnam local representative. The American Mathematical Society is to meet with this section. In Physics Professor L. B. Loeb is secretary *pro tem* and local representative. The American Physical Society and the American Meteorological Society are meeting with the physicists. In Chemistry the secretary *pro tem* and local representative is Professor G. K. Rollefson. The Pacific Intersectional Division of the American Chemical Society joins with the section. In Astronomy Professor C. D. Shane is secretary *pro tem* and local representative. The Astronomical Society of the Pacific is to meet with this section.

In the Zoological Sciences the secretary *pro tem* and local representative is Professor S. F. Light. The Western Society of Naturalists, the Western Division of the American Society of Ichthyologists and Herpetologists, the Pacific Coast Branch of the American Association of Economic Entomologists, the Entomological Society of America and the San Francisco Aquarium Society will meet with the zoologists. In the Botanical Sciences Professor R. M. Holman is secretary *pro tem* and local representative. The Botanical Society of America, the American Phytopathological Society and the American Society of Plant Physiologists are meeting with the botanists. The Genetics Society of America and the Ecological Society of America will also meet with the zoologists and botanists. In Anthropology the secretary is Professor W. M. Krogman and the local representative is Professor A. L. Kroeber. The American Anthropological Association is to meet with this section. In Psychology Professor J. A. McGeoch is secretary and Professor Warner Brown is local representative. The Western Psychological Association joins with the section.

In the Social and Economic Sciences Professor Robert D. Calkins, University of California, has been appointed secretary *pro tem* and is taking charge of the program; the contributing organizations are the Econometric Society, represented by Professor J. B. Canning, the San Francisco Chapter of the American Statistical Association, represented by Professor B. F. Haley, and the Social Science Research Confer-

ence of the Pacific Coast, represented by Professor Stuart Daggett. In the Historical and Philological Sciences Professor Chauncey D. Leake is secretary *pro tem* and local representative. The History of Science Society will meet with this section.

In Engineering the secretary *pro tem* and local representative is Professor B. M. Woods. The American Society of Mechanical Engineers, the Pacific Coast Section of the American Society of Agricultural Engineers, the American Geophysical Union and the Institute of Aeronautical Sciences are to meet with the engineers. In the Medical Sciences Dr. Earl B. McKinley is secretary and Dr. J. N. Force is local representative. The Pacific Coast Branch of the Society for Experimental Biology and Medicine and the California State Veterinary Medical Association will meet with this section. In Agriculture the secretary *pro tem* and local representative is Dean C. B. Hutchison. The Western Society of Soil Science and the Western Branch of the American Society of Agronomy are meeting with the agriculturists. In Education Dean G. N. Kefauver is secretary *pro tem* and Professor Noel Keys is local representative.

Headquarters and Registration

General headquarters for the meeting will be in the Stephens Union Building on the campus near Sather Tower. The building is centrally located with reference to the buildings in which sessions are scheduled and will be a convenient social gathering place for members attending the meeting. Officers of the association will be quartered in the Hotel Durant; otherwise no assignments of hotel headquarters for individual sections and societies have been made.

The main registration office will be in the Men's Club Room of the Stephens Union, and a subsidiary registration desk will be located in the lobby of the Gymnasium for Men during the general evening sessions of the meeting. Registration will be open, upon payment of a fee of $1.00, to all persons who are interested in the advancement of science or education.

Each registrant receives a copy of the program, an identification card and a badge. Registration will be necessary for attendance upon the general reception, participation in excursions and other events. The registration office will include an information desk and will handle reservations for luncheons, dinners, excursions and other activities. Mail, telegrams, etc., may, if desired, be addressed to Headquarters A. A. A. S., Stephens Union, Berkeley, Calif.

Hotel Accommodations

The following Berkeley hotels are available in the immediate vicinity of the campus:

Hotel Durant: Detached bath, single occupancy from $2.00, double, $2.50; with bath, single occupancy from $2.50, double $3.00.

Hotel Whitecotton: Detached bath, single occupancy from $2.00, double $3.00; with bath, single occupancy from $2.50, double $3.00.

Hotel Claremont (one mile from the campus): Detached bath, single occupancy from $2.00, double $3.00; with bath, single occupancy $2.50, double $4.00; suites for from 3 to 5 persons, per person, $2.00.

Hotel Carleton: Detached bath, single occupancy from $1.50, double $2.00; with bath, single occupancy $2.00, double $3.00.

Berkeley Inn: Detached bath, from $1.00; with bath, from $1.50.

In addition to these hotels, excellent accommodations may be obtained in the following houses, which are operated under university auspices:

International House: Accommodations for men and women separately, detached bath, $1.50 per day, $7.00 per week.

Bowles Hall: Accommodations for men only, detached baths, suites of three rooms for two persons, per person $1.50 per day, $7.00 per week.

Information as to other rooming and boarding places will be available at the registration office. Members attending the meeting, particularly those who desire accommodations in the International House or Bowles Hall, are urged to make reservations in advance.

While accommodations in the vicinity of the campus will probably be adequate to care for all who desire them and will be extremely convenient for attendance upon the sessions, some members may prefer to stay in Oakland or San Francisco hotels. Transit from downtown Oakland by street car requires about twenty minutes; from San Francisco by ferry and electric train, about forty-five minutes.

Transportation

Those planning to attend the Berkeley meeting will be able to take advantage of summer excursion tickets at greatly reduced rates for the round trip. Season tickets are good until October 31, but from some points tickets for a forty-five day limit may be purchased at lower rates than for season tickets. Reduced rates for shorter periods are also available from many points west of the Rocky Mountains. It is advisable to consult the local ticket agent for information regarding stop-over privileges and for other details.

In addition to train routes, transcontinental air lines and motor transport are available, and it is possible to go by steamer from eastern ports through the Panama Canal to San Francisco.

For automobile parties the most direct transcontinental routes are by way of the Lincoln and Victory highways, but northern and southern routes are also available. In the west auto camps along the way provide convenient over-night stopping places. A visitor's registration permit should be obtained at the first office of the California Automobile Association encountered on the route. The offices of this organization are prepared to supply maps and touring information. Eastern visitors who plan to make a tour of California will find it distinctly to their advantage to have their own automobiles, for all the principal scenic attractions of the state are reached by the highway system and auto camps are everywhere available.

Those coming to the meeting from coast points will find that motor transport as well as rail lines offer reduced summer rates. Pacific coast ports are also connected with San Francisco by coastwise steamers, which offer cheap rates and attractive service. Air lines connect the principal western cities with Oakland.

Exhibits and Demonstrations

A special committee is making arrangements for exhibits, demonstrations, etc. Besides the departmental activities noted below, scientific apparatus of a novel type and contributed exhibits from participating societies and individuals will be included.

On Tuesday afternoon university departments and institutes will hold open house for visiting members of the association. Special types of apparatus and numerous departmental exhibits will be open for inspection, and informal demonstrations of research materials will be given. Permanent exhibits, as well as some of the specially arranged departmental exhibits, will be open for inspection throughout the week.

Social Events

The general reception for visiting members will be given in Hearst Gymnasium, following the opening general session in the Gymnasium for Men. Admission will be by identification card.

A number of luncheons, dinners, smokers and other social gatherings are being arranged by the various participating societies and groups, as noted under sectional and society programs.

The Women's Section Club, an organization of women interested in various cultural activities, has accepted sponsorship for a special program of entertainment for women, including garden tours, teas, short excursions and informal exhibits of a cultural nature. Wives of members who intend to participate in these activities are requested to register at headquarters. Detailed information will be contained in a special leaflet distributed on registration. No separate registration fee will be charged.

Excursions

The following excursions to nearby points of interest have been arranged by Professor R. W. Chaney. Details as to routes, starting times, expenses, etc., will appear in the program.

(1) Branch of the College of Agriculture of the University of California, Davis, on Saturday. At Davis visitors may have a choice of guidance by several groups of faculty members, who will show various phases of agricultural research.

(2) Leland Stanford Junior University, on Friday afternoon. A visit to the laboratories and other points of interest at Stanford University and Palo Alto.

(3) Mt. Tamalpais. A trip by motor bus north of the Golden Gate to Mt. Tamalpais and the redwood forest at Muir Woods National Monument.

(4) Strawberry Canyon and the Berkeley Hills. A trip on foot under the guidance of members of university departments for observation of typical central Californian flora, fauna and geological structure, including a visit to the Botanical Garden of the university.

(5) Mt. Hamilton and the Lick Observatory on Friday afternoon, by automobile. Demonstration of the observatory and observation through the telescopes after dark.

(6) San Francisco. On Saturday morning members of the association are invited to inspect the exhibits and departments of the California Academy of Sciences and the Steinhart Aquarium in Golden Gate Park. A buffet luncheon will be served at noon, and at two o'clock, through the courtesy of the San Francisco Chamber of Commerce, the excursion will be continued by a motor bus tour through the city.

(7) Yosemite National Park. A week-end excursion to the park will be arranged, provided sufficient applications are received.

The San Francisco Bay Region

The San Francisco Bay Region is the center of the commercial and industrial activities of central and northern California. An almost continuous succession of communities with a combined population of about 1,300,000 extends along the shores of the bay. Southward from San Francisco on the peninsula are Burlingame, San Mateo, Hillsboro, Palo Alto, Los Altos, Santa Clara, San Jose and many other smaller towns. Northward from San Francisco on the Marin Peninsula are San Rafael, Sausalito, Mill Valley, San Anselmo and many smaller towns and resorts picturesquely located amid attractive natural surroundings. On the eastbay shore are the larger cities of Richmond, Berkeley, Oakland, Alameda, Piedmont, together with numerous smaller towns.

San Francisco contains many places of interest:

Chinatown, with its oriental shops, restaurants and theaters; Nob Hill, Russian Hill, Telegraph Hill and other hill sections, with their unique cable cars; the Presidio, headquarters of the U. S. Army Ninth Corps Area; Golden Gate Park, with its Japanese tea garden, the California Academy of Sciences, the Steinhart Aquarium and the de Young Museum; the Civic Center, including the City Hall, the Exposition Auditorium, the Opera House, the Public Library and other buildings; the Palace of the Legion of Honor with its art collections; many notable business structures; and the extensive port facilities of the Embarcadero. The city is famous for the number and variety of its eating places.

Berkeley, Oakland, Alameda and Piedmont make up a single continuous community lying on the eastbay shore directly across from San Francisco. While the population of these cities is largely suburban, about 100,000 passengers are carried daily by the transbay systems, the convenience of access to rail and water transportation has led to the development of many important industries, including oil refining, sugar refining, shipbuilding, soap manufacturing, automobile assembling, etc.

Outside of San Francisco points of interest include the Sunnyvale Naval Station, base of the dirigible *Macon;* the Mare Island Navy Yard at Vallejo; Muir Woods, the redwood forest and Mt. Tamalpais on the Marin Peninsula; the Oakland Airport, terminus of transcontinental air lines and the great deciduous fruit section of the Santa Clara Valley. Besides the University of California at Berkeley and Stanford University at Palo Alto, there are numerous smaller educational institutions, among them Mills College in Oakland, St. Mary's College at Moraga, Santa Clara University at Santa Clara; the University of San Francisco and the medical schools and hospitals of the University of California and Stanford University in San Francisco. Four bridges cross the bay at various points and two notable ones are under construction; the huge suspension bridge across the Golden Gate, with towers over 750 feet high, one of which is nearing completion, and the five-mile long double suspension transbay bridge from San Francisco to Oakland.

The eastbay communities are served by a single street car and motor bus system. The University of California is located in the center of Berkeley close to main street car and transbay lines and may be reached from railroad stations by use of these systems.

The summer climate of the San Francisco Bay Region is cool, and visitors are advised to bring light wraps for evening wear.

Scenic Attractions and Vacation Opportunities

Those who come to the meeting, particularly from the east, will have an excellent opportunity to combine a vacation trip with their attendance upon the meeting. Trips may be arranged without extra cost to come by one route and return by another, with liberal stopover privileges to visit points of interest along the way. Groups visiting the national parks—Yosemite, Sequoia, Lassen Volcanic, Crater Lake, Rainier, Grand Canyon, Yellowstone and others—are advised to get in touch with the park superintendents, with whom special arrangements may be made for securing the free services of the national park educational staff.

Many of the scenic attractions and vacation centers of California are readily accessible from the San Francisco Bay Region. Northward along the coast among the redwood forests are numerous popular resorts, particularly the Russian river region (74 miles) and, more distant, Eureka (284 miles), center of the redwood lumber industry. This region is traversed by the famous Redwood Highway, which connects with highways through Oregon and Washington. Inland northward and eastward are the gold country (176 miles), Mt. Shasta (305 miles), Mt. Lassen (280 miles), Feather River (225 miles) and Lake Tahoe (230 miles). Southward and eastward are Yosemite (187 miles), General Grant (237 miles) and Sequoia (260 miles) national parks; and southward, the Santa Cruz mountains (75 miles) with numerous summer resorts, the Monterey Bay country (122 miles) and Santa Barbara (367 miles). Los Angeles (470 miles) and other points in Southern California may be reached overnight by train or steamship or by automobile via coast or valley highways.

Paved highways lead to all these regions, and motor bus as well as rail transportation is available. Automobile parties will find it convenient to stay at auto camps, which are located at convenient intervals along the way. Upon individual request Californians, Inc., San Francisco, will send to members of the association a sixty-four-page illustrated booklet descriptive of the San Francisco Bay Region and outlying scenic attractions and vacation centers and will supply specific information as desired.

General Sessions

The opening general session on Monday evening will be devoted to the presidential address of Professor J. H. Hildebrand, president of the Pacific Division. This session will be followed by a reception tendered by the president of the university to the officers and members of the association and participating societies and invited guests. Dr. John C. Merriam, of the Carnegie Institution of Washington, will address the general session on Wednesday evening and President Karl T. Compton, of the Massachusetts Institute of Technology, that on Friday evening. General sessions will be held on Tuesday and

Thursday evenings also. Tuesday evening will be used for the Maiben Lecture, which will be given by Dr. L. Dudley Stamp, Director of the Land Utilization Survey of Britain, on the topic "Planning the Land for the Future." The Thursday evening session will be addressed by Dr. E. B. Wilson, of Harvard University.

SECTION MEETINGS AND SPECIAL PROGRAMS

The Section on Mathematics (A) will meet jointly with the American Mathematical Society, which will hold its principal sessions on Wednesday, both morning and afternoon. There will be a luncheon between the sessions.

The Section on Physics (B) will meet jointly with the American Physical Society and the American Meteorological Society. The American Physical Society and the Astronomical Society of the Pacific will hold a joint session on Tuesday afternoon, with papers by invitation on the general subject, "Spectroscopy in Astro-Physics." They will also hold an all-day symposium on Wednesday, on the structure of the nucleus and its disintegration by rapidly moving particles and cosmic rays. The speakers and their subjects are as follows: Professor R. J. Van de Graaf, of Massachusetts Institute of Technology, "The Production of High Energy Radiations"; Professor C. C. Lauritsen, of the California Institute of Technology, "Disintegration by Protons and Deutons"; Professor E. O. Lawrence, of the University of California, "Recent Disintegration Experiments at the University of California"; Dr. Thomas Johnson, of the Bartol Research Foundation of Philadelphia, "Recent Cosmic Ray Investigations and the Latitude Effect"; Dr. Carl D. Anderson, of California Institute of Technology, "Nuclear Disintegrations and Cosmic Rays"; and Dr. Merle A. Tuve, of the Carnegie Institution. Discussion will be led by various mathematical physicists, including Professors J. R. Oppenheimer and Felix Bloch.

On Thursday there will be a symposium on fundamental physical constants, with six papers by invitation from the following speakers: Professor R. A. Millikan and Dr. Jesse DuMond, of the California Institute of Technology; Professor P. A. Ross and Professor Paul H. Kirkpatrick, of Stanford University; Professor W. V. Houston, of the California Institute of Technology; and Professor R. T. Birge, of the University of California. On Friday and Saturday mornings the Physical Society will meet for its regular session of contributed ten-minute papers.

The American Meteorological Society will hold sessions on June 19, 20 and 21, with discussion of various phases of meteorology and climatology, giving particular attention to recent developments in forecasting. Arrangements are being made for an informal luncheon of meteorologists and their friends, for a visit to the Weather Bureau office at the Oakland airport and for an excursion to the Naval Air Station at Sunnyvale.

The Section on Chemistry (C) has as the principal feature of its program two symposia conducted by the Pacific Intersectional Division of the American Chemical Society, at dates to be announced later. The topics for discussion are "Fundamental Biochemistry" and "Recent Advances in Physical Chemistry." There will also be a number of general sessions and the usual dinner.

The Section on Astronomy (D) will meet jointly with the Astronomical Society of the Pacific in general sessions for contributed papers on Thursday and Friday. Members will also participate in the symposium with the American Physical Society.

The newly organized Society for Research on Meteorites will hold morning and afternoon sessions with contributed papers on Tuesday and Wednesday.

The Section on Geology and Geography (E) will not participate in the program at Berkeley. The Committee on the Oceanography of the Pacific will hold a luncheon meeting for its members with an informal program, consisting of reports on recent and current researches in the oceanography of the Pacific coast of Canada and the United States. The committee will also consider the organization of a society to consist of those engaged in oceanographic research on the Pacific coast. The program has been arranged by Dr. T. Wayland Vaughan, chairman of the committee.

The Section on Zoological Sciences (F) and the Western Society of Naturalists will have special programs on experimental morphogenesis and parasitology and will conduct jointly a symposium on "The Life History of Protozoa." Another joint meeting will be held by the American Association of Economic Entomologists, Pacific Slope Branch, and the Entomological Society of America. The American Association of Economic Entomologists will hold sessions in the mornings and afternoons of Wednesday and Thursday, a dinner on Thursday evening, a session on Friday morning and field trips on Friday afternoon. The Wednesday afternoon session will be held jointly with the California State Veterinary Medical Association.

Individual society meetings, with addresses and contributed papers, will also be held by the Western Society of Naturalists, the Entomological Society of America, the California State Veterinary Medical Association, the San Francisco Aquarium Society and the American Society of Ichthyologists and Herpetologists. Visits to the neighboring aquarium, zoological garden and museums will also be undertaken.

A general dinner for biologists will be sponsored by the Western Society of Naturalists.

The Section on Botanical Sciences (G) will hold two symposia: on "The Absorption and Accumulation of Mineral Elements by Plants" and on "The Origin and Development of North Pacific Floras."

Contributed papers will be presented in joint sessions beginning on Tuesday morning, in which this section, the Botanical Society of America, the American Society of Plant Physiology and the American Phytopathological Society will participate. There will be a special session addressed by Mrs. Ynez Mexia on her explorations of the upper Amazon.

The Sections on Botany and Zoology will collaborate with the Western Society of Naturalists, the Botanical Society of America and the Genetics Society of America in presenting a symposium on some subject concerning genetics, which will probably consume an entire day. The Ecological Society of America, under the joint auspices of the two sections, will hold two half-day sessions for contributed papers.

The Section on Anthropology (H) will hold a series of joint meetings with the Pacific Division of the American Anthropological Association. The Wednesday morning session will be devoted to problems of southwestern archeology. Among other papers, F. M. Setzler, of the National Museum, will discuss his cave work in Texas, Dr. S. B. D. Aberle will present a paper on vital statistics of the Indians of the Southwest, and R. L. Beals will outline problems of Southwestern and Mexican contacts. The Thursday morning program will be given over to Southwest and California ethnology. Papers will be contributed by members of the Department of Anthropology of the University of California. The discussion of the Friday morning session will center upon problems of methodology in American anthropology. Dr. Franz Boas will present a paper on "Scope and Method of Anthropological Research." If the number of papers warrants, sessions will convene on Thursday and Friday afternoons, devoted to physical anthropology and descriptive archeology. A joint luncheon or dinner is planned.

The Section on Psychology (I) will hold a symposium on Thursday afternoon on the subject "Can Personality be Measured?" and morning and afternoon sessions on Friday and Saturday jointly with the Western Psychological Association. The presidential address of that association will be given on Friday evening following the dinner.

The Section on Social and Economic Sciences (K) will hold a joint session with the Econometric Society, which will have a program extending through five or six sessions. Arrangements have been made for papers by Dr. Fritz Machlup, of Austria; Dr. George Peterson and Dr. Leo Rogin, of the University of California; Dr. E. L. Grant, Dr. J. B. Canning and Dr. Holbrook Working, of Stanford University; Mr. O. P. Wheeler, of the San Francisco Federal Reserve Bank; Dr. Norman J. Silberling, and others. George Bousquet, of the University of Algiers, will present a paper. On Saturday, following a dinner, there will be a joint session of Section K, the Econometric Society and the San Francisco Chapter of the American Statistical Association, at which Dr. W. L. Crum, of Harvard University, will present a paper. A program on "Land Utilization" is being arranged for a joint session with the Section on Agriculture (O).

The Section on Historical and Philological Sciences (L) will meet jointly with the History of Science Society for contributed papers and one symposium. The latter will be on the topic "The Hearst Medical Papyrus and Its Relation to Other Medical Papyri." The speakers will be Dr. Harold Lutz, Dr. Sanford Larkey and Professor Chauncey D. Leake, all of the University of California.

The Section on Engineering (M) for its main activity is sponsoring a national meeting of the Aeronautics and Hydraulics Divisions of the American Society of Mechanical Engineers on June 19, 20 and 21. In addition the hydrology division of the American Geophysical Union and the American Society of Agricultural Engineers have arranged a joint session to be held in cooperation with the American Society of Mechanical Engineers and as a part of the program of the Section on Engineering. The aeronautics portion of the meeting is further sponsored by the Institute of the Aeronautical Sciences. Among the more prominent speakers will be Professor Bakhmeteff, of Columbia University, Dr. Theodor von Kármán, of the California Institute of Technology, and Mr. Elmer A. Sperry, Jr., of the Sperry Gyroscope Company.

Tuesday and Wednesday will be devoted to morning and afternoon sessions at the University of California. A dinner meeting will be held on Wednesday evening. Thursday will be given over to a morning session at Stanford University in Palo Alto and an afternoon excursion to points of engineering interest. Professor William F. Durand, of Stanford University, has been appointed honorary chairman of the meeting.

The Section on Medicine (N) will hold four sessions at the Berkeley meeting, two of which will be given over to a consideration of the field of endocrinology and two of which will deal with aspects of hygiene and parasitology. The first session will be devoted to a symposium on general phases of the endocrine problem under the general title of "A Survey and Evaluation of the Present Status of Endocrine Investigations." Professor E. M. K. Geiling, of the department of pharmacology, the Johns Hopkins Uni-

versity, will speak on "Present Problems"; Professor Vincent du Vigneaud, of the department of biochemistry, George Washington University School of Medicine, will speak on "Chemistry"; while Professor James M. Luck, department of biochemistry, Stanford University, will speak on "Interrelationships."

The second session will be addressed by a distinguished scholar in the field of endocrine studies, and this address will be followed by a series of shorter papers dealing with original investigations concerning the various hormones. The third and fourth sessions will be devoted to problems in the general fields of hygiene and parasitology, and the details of these programs will be announced later.

The Pacific Coast Branch of the Society for Experimental Biology and Medicine will conduct its regular June meeting in conjunction with Section N. There will be a dinner on one evening, followed by contributed papers.

The California State Veterinary Medical Association will meet jointly with the American Association of Economic Entomologists for one session. The association will also meet on Tuesday, Wednesday and Thursday.

The Section on Agriculture (O) contemplates conducting several meetings and conferences. The program includes a conference on the general topic "Land Utilization," under the direction of Dr. H. E. Erdman, of the Giannini Foundation for Agricultural Economics, University of California. The conference will be addressed by Dr. L. Dudley Stamp, in charge of the land utilization survey of Great Britain. A symposium will be conducted under the auspices of the section, with Dr. W. W. Robbins as chairman, on the topic, "Weed Control, with Particular Emphasis on the Physiological Problems Involved."

A joint symposium with the Western Society of Soil Science, covering an entire day, will be held on the topic, "Soil Phosphate." The Western Society of Soil Science will also hold four sessions for contributed papers, beginning on Monday. The American Society of Agronomy, Western Branch, will hold meetings for contributed papers and a dinner.

The Section on Education (Q) has taken as the central theme of its program "The Applications of Science to Different Aspects of Education." Six areas have been submitted to the membership for an indication of studies under way and to be reported on at summer meetings, *viz.:* (1) Educational problems arising from the application of science to modern society; (2) application of science to the diagnosis and treatment of individual learning difficulties; (3) applications of science to the solution of problems of school finance; (4) applications of science to the problems of teaching personnel; (5) applications of science to the problems of guidance, and (6) applications of science to the non-school educational agencies.

The four with the most promising group of investigations for report will be used in the four separate sessions. The four symposia will involve opening presentations, discussions by a selected panel and general discussion by the full group in attendance.

The separate meetings of the section will be held on June 19 and 20. The joint meetings with the Section on Psychology will be held on June 21. One half day will be given to a consideration of "The Measurement of Personality." The theme of the second joint session has not yet been determined.

General Notices

Full details of all events will be found in the final program issued to members and visitors on registration in Berkeley. Material for that program is gathered by the secretaries of the various organizations and transmitted to Professor R. E. Clausen, Chairman of the Local Committee, Berkeley, California. In order to be included in that program items must reach Berkeley not later than June 1.

SCIENTIFIC EVENTS

CARNEGIE GRANTS TO BRITISH COLONIAL AND DOMINION MUSEUMS

According to *The Museum News,* the Carnegie United Kingdom Trust has liberalized the conditions for grants to British museums. During the first three years that the grants were available they were restricted to municipal museums in towns of 10,000 to 70,000 population. During the remaining two years these restrictions will be removed and any active museum in Great Britain may apply for a grant for museum development. These grants, obtainable through the Joint Committee of the Museums Association and the Carnegie Trustees, will be not more than £250 each. The grants can not be used for ordinary expenses, but must go into reorganization and experiment in museum development. In addition the Carnegie trustees will consider, through the committee, applications for grants of about £200 to aid museums in extending their services to rural areas.

The Museums Association announces that it is prepared to receive applications from museums in Newfoundland, Southern Rhodesia and the British colonies for grants of not more than £1,000 each. In general the grants may be used for study of accumulated material and publication of results, reorganization of collections, purchase of exhibition equipment, develop-

ment of educational work, and to permit curators to visit other museums. Grants will be restricted to museums that have qualified curators and assurance of active support by governmental or other authorities concerned. The Carnegie Corporation of New York has made available $54,000 for these grants, and an additional $200,000 for grants in Canada, Australia, New Zealand and South Africa.

APPROPRIATIONS FOR MIGRATORY-BIRD REFUGES

ONE million dollars of Emergency Conservation Work funds were allocated for migratory-bird restoration purposes by President Roosevelt on April 19. Executive Order No. 6684 authorizes the purchase and rental of lands as refuges for migratory birds and other forms of wild life that constitute a diminishing natural resource. Acquisition and proper development of the refuge lands will provide protection not only for the depleted wild-life resources but for the lands themselves. The work incident to acquisition and improvement will also provide employment on useful public work.

This use of ECW funds, while not governed or limited by the Migratory Bird Conservation Act of 1929, will further the purpose of that act, which is to establish bird refuges. That act authorized appropriations for land acquisition, but Congress has not yet made the funds fully available.

The President's order was issued under the provisions of the Unemployment Relief Act, the purpose of which, as stated in Section 1, are: (1) To relieve unemployment; (2) to provide for the restoration of the country's depleted natural resources, and (3) to provide for the advancement of an orderly program of useful public works. Section 2 of the act authorizes acquisitions of land for these purposes.

Following is the text of the order:

WHEREAS, It is necessary to purchase or rent various lands in order to provide suitable refuges for, and to protect and conserve, migratory birds and other wild life constituting depleted natural resources of the United States; and,

WHEREAS, The work and improvements necessary to be performed and made upon such lands to make them suitable and proper refuges for migratory birds and other wild life will provide protection for such lands from forest fires, floods and soil erosion, and plant pest and disease, and aid in the restoration of the country's depleted natural resources; and,

WHEREAS, The purchase of such lands will provide employment for citizens of the United States who are unemployed; now,

Therefore, By virtue of and pursuant to the authority vested in me by the act of Congress entitled "An act for the relief of unemployment through the performance of useful public work, and for other purposes," approved March 31, 1933 (48 Stat. 22), the purchase or rental of such lands as are suitable for the aforesaid purposes is hereby authorized; and by virtue of the authority vested in me by the Fourth Deficiency Act, fiscal year 1933, approved June 16, 1933 (48 Stat. 274), the sum of $1,000,000 is hereby allocated for the purchase or rental of such lands (including the costs incident to purchase or rental) from the appropriation made by the said deficiency act for carrying into effect the provisions of the said act of March 31, 1933.

The sum herein allocated shall be transferred by the Treasury Department to the credit of the War Department for the purchase or rental of such lands (including the costs incident to purchase or rental) and shall, upon request of the Chief of Finance, under direction of the Director of Emergency Conservation Work, be transferred by the Treasury to the credit of the Department of Agriculture, and the funds so transferred shall be withdrawn on requisition by the Secretary of Agriculture.

THE UNITED STATES BOTANIC GARDEN

A JOINT resolution authorizing the appointment of a Planning Committee in connection with the United States Botanic Garden and for other purposes was introduced in the House of Representatives on April 19 by Representative Keller. It was referred to the Committee on the Library and ordered to be printed. The resolution follows:

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That a committee be, and is hereby, appointed, which is to be known as the "Planning Committee for the United States Botanic Garden," consisting of the following members:

Honorable Frederic A. Delano (chairman National Capital Park and Planning Commission), chairman; Senator Alben W. Barkley (chairman of the Joint Committee on the Library), vice-chairman; Representative Kent E. Keller (chairman of the House Committee on the Library), second vice-chairman; Senator Peter Norbeck (member of Committee on Agriculture and Forestry); Representative Robert Luce (former chairman of the House Committee on the Library); Frederick V. Coville (acting director of the National Arboretum); B. Y. Morrison (head of Division of Foreign Plant Introduction, Bureau of Plant Industry, Department of Agriculture); William R. Maxon (associate curator, Division of Plants, Smithsonian Institution); C. Stuart Gager (director of the Brooklyn Botanic Garden); Leicester B. Holland (chief, Division of Fine Arts, Library of Congress); Oakes Ames (director of the Arnold Arboretum, Harvard University); George T. Moore (director of the Missouri Botanical Gardens); L. H. Bailey (professor of horticulture, Cornell University); H. H. Bartlett (director of Botanical Garden and Arboretum, University of Michigan); Rodney H. True (director of the Morris Arboretum, University of Pennsylvania); Mrs. Frank B. Noyes (special representative of the Garden Club of America); Mrs. Fairfax Harrison (rep-

resenting Garden Club of America); Harlan P. Kelsey (member of the Massachusetts Horticultural Society); Robert Pyle (chairman of Committee on Botanical Gardens and Arboretums, American Association of Nurserymen); John G. Bradley (clerk of the House Committee on the Library), executive secretary.

SEC. 2. (a) The duty of the Planning Committee (hereinafter referred to as the "Committee") shall be to make a careful study of the United States Botanic Garden (hereinafter referred to as the "Garden") in comparison with other botanic gardens, arboretums, herbariums, botanic libraries, and similar institutions, with a view to its improvement as a scientific, educational, and aesthetic establishment.

(b) It shall also be the duty of this Committee to study other Federal institutions having functions in common with the Garden, particularly the National Arboretum, the Smithsonian Institution, the Library of Congress, and the Department of Agriculture, with a view to correlating these common functions for the use and improvement of the Garden.

(c) The Committee shall make a report of its findings to the Joint Committee on the Library, together with recommendations for the future administration and conduct of the Garden.

SEC. 3. The chairman of the Committee, or any member thereof authorized by him, shall be empowered to examine the files, records, and inventory of various other Federal establishments pertinent to this investigation and for the purposes herein set out.

SEC. 4. The members of the Committee shall receive no salaries for their services, but necessary traveling expenses and other expenses incident to their duties shall be paid.

SEC. 5. For the purpose of carrying out the provisions of this Act the sum of $5,000, or so much thereof as may be needed, is hereby authorized to be appropriated.

SEC. 6. No disbursements on this account shall be made for any purpose except on the authority and approval of the chairman of the aforesaid Committee.

ELECTIONS OF THE NATIONAL ACADEMY OF SCIENCES

AT the meeting of the National Academy of Sciences held in Washington on April 23, 24 and 25, Dr. Thomas Hunt Morgan, director of the William G. Kerckhoff Laboratories of the Biological Sciences of the California Institute of Technology and past president of the academy, was elected foreign secretary to succeed Dr. Robert A. Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the Executive Council of the California Institute of Technology, who asked to be relieved of the office which he has held for the past fifteen years. Dr. Roger Adams, professor of organic chemistry at the University of Illinois, and Dr. H. S. Jennings, professor of zoology at the Johns Hopkins University, were elected members of the council.

Members elected were:

Vannevar Bush, professor of electrical engineering and vice-president of the Massachusetts Institute of Technology.

Herbert Spencer Gasser, professor of physiology, Cornell University Medical College, New York.

Edmund Newton Harvey, professor of physiology, Princeton University.

Dennis Robert Hoagland, professor of plant nutrition, University of California.

Ernest Orlando Lawrence, professor of physics, University of California.

James Flack Norris, director of the research laboratory of organic chemistry, Massachusetts Institute of Technology.

John Howard Northrop, biochemistry, member of the Rockefeller Institute.

Charles Palache, professor of mineralogy, Harvard University.

Thomas Milton Rivers, pathology, member of the Rockefeller Institute.

Edward Sapir, Sterling professor of anthropology and linguistics, Yale University.

Elvin Charles Stakman, plant pathologist, U. S. Department of Agriculture.

Harry Shultz Vandiver, associate professor of mathematics, University of Texas.

Norbert Wiener, professor of mathematics, Massachusetts Institute of Technology.

Sewall Wright, professor of zoology, University of Chicago.

Foreign associates elected were:

Dr. V. F. K. Bjerknes, professor of meteorology of the University of Oslo.

Dr. Robert Robinson, Waynflete professor of chemistry at the University of Oxford.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM HENRY WELCH, recognized leader of the medical sciences in the United States, professor emeritus of the history of medicine in the Johns Hopkins Medical School, previously professor of pathology, first dean of the school and director of the School of Hygiene and Public Health, died on April 30 in his eighty-fifth year.

ONE of the three gold medals of the National Institute of Social Sciences, New York City, has been awarded to Dr. Walter Bradford Cannon, George Higginson professor of physiology at the Harvard Medical School. The medal will be presented to Dr. Cannon by Dr. John A. Hartwell, director of the New York Academy of Medicine, at the annual dinner of the institute, which will be given on May 10.

THE doctorate of laws was conferred on Dr. Har-

rison E. Howe, editor of *Industrial and Engineering Chemistry*, at the Founder's Day exercises on March 13 of Southern College, Lakeland, Florida. Dr. Howe delivered the Founder's Day address.

THE University of St. Andrews will confer at the graduation ceremonial to be held on June 29 the honorary degree of LL.D. on Sir Frederick Gowland Hopkins, president of the Royal Society and professor of biochemistry at the University of Cambridge, and on Lord Moynihan, emeritus professor of surgery at the University of Leeds.

THE President of the French Republic has conferred La Croix de Chevalier de la Légion d'Honneur upon Sir Henry Wellcome, founder of the Wellcome Research Institution and head of Burroughs Wellcome and Company, London, manufacturers of fine chemicals.

PROFESSOR JAMES G. NEEDHAM, of Cornell University, was the guest of honor of the Cornell alumni of the University of Tennessee at a dinner given during a recent visit to the South. A hundred persons attended the banquet, at which Dr. Needham made the address.

AT the first annual meeting of the enlarged American Institute of Nutrition, held at Cornell Medical Center, New York City, on March 28, a constitution was adopted and the following officers were elected for 1934–35: *President,* John R. Murlin; *Vice-president,* Eugene F. DuBois; *Treasurer,* Walter M. Boothby; *Secretary,* Icie G. Macy; *Members of the Council,* Roland M. Bethke, Agnes Fay Morgan and Arthur H. Smith.

THE first meeting of the newly organized New York City Branch of the Society of American Bacteriologists will be held at Teachers College, Columbia University, on May 8. The following officers will be installed: *Chairman,* Dr. L. W. Famulener, St. Luke's Hospital; *Vice-chairman,* Dr. Wm. Reiner-Deutsch, Doctor's Hospital; *Secretary-treasurer,* Dr. William W. Browne, College of the City of New York.

DR. WALTHER has been elected president, Dr. Siredey vice-president, Professor Achard general secretary, and Dr. Brouardel annual secretary, of the Paris Academy of Medicine.

AT the annual meeting of the trustees of Science Service, which was held in Washington, D. C., on April 25, the retiring officers were reelected. They are Dr. J. McKeen Cattell, *president;* Dr. William H. Howell, *chairman* of the executive committee; H. L. Smithton, *treasurer,* and Watson Davis, *secretary* of the corporation and *director* of the service.

DR. CARL J. P. SKOTTSBERG, professor of botany at the University of Upsala, has been appointed visiting professor of botany at Yale University. He will direct research on problems of the Pacific area.

PROFESSOR KARL PEARSON has been appointed Heath Clark lecturer at the University of London for the year 1934.

PROFESSOR FRANK W. GARRAN, of Dartmouth College, has been elected dean of the Thayer School of Civil Engineering to succeed Raymond R. Marsden, who is on leave of absence this year.

PROFESSOR MELVIN L. ENGER, a member of the faculty of the University of Illinois since 1907 and head of its department of theoretical and applied mechanics since 1926, has been appointed dean of the College of Engineering and director of the Engineering Experiment Station. Dr. Arthur Cutts Willard, who was recently elected president of the university, has been serving as acting dean of the College of Engineering this year. To fill the vacancy caused by the election to the deanship, Professor Fred B. Seely, a member of the faculty since 1909, has been named head of the department of theoretical and applied mechanics. Professor O. A. Leutwiler has been appointed head of the department of mechanical engineering.

DR. C. R. BURNHAM has been appointed assistant professor of genetics, and Dr. L. S. Bennett, instructor in agronomy and genetics, at West Virginia University.

DR. GEORGE OLDS COOPER, of the University of Wisconsin, has been appointed assistant professor of botany at Smith College.

T. G. HARBISON has been appointed curator of the Botanical Herbarium of the University of North Carolina. He will assume his new work on July 1. Mr. Harbison is known as a field botanist, having collected throughout the South for many years for the Arnold Arboretum and for the Biltmore Herbarium and Nurseries. For the past several months he has been assisting in arranging the Ashe Herbarium, recently acquired by the University of North Carolina.

PROFESSOR J. R. DYMOND, associate professor of systematic zoology at the University of Toronto, and assistant director of the Royal Ontario Museum of Zoology, has been appointed director of the museum, succeeding the late Professor B. A. Bensley.

AN expedition under the auspices of the department of tropical medicine of Harvard University sailed on April 25 for Africa. The expedition has as its objects the continuation of investigations carried on by Dr. Richard P. Strong in Guatemala upon the control and elimination of onchocerciasis, and the development of scientific and medical knowledge of the Katanga region. It is expected the party will be absent for about six months. The members of the expe-

dition are as follows: Dr. Richard P. Strong, director; Dr. Joseph C. Bequaert, entomologist; Dr. Jack H. Sandground, helminthologist; Henry E. Mallinckrodt, laboratory assistant and photographer; R. Stuyvesant Pierrepont, Jr., zoological assistant, and Byron L. Bennett, technician.

LIEUTENANT MARTIN LINDSAY and Lieutenant A. S. T. Godfrey left Copenhagen on April 10 for West Greenland, where they will join A. Croft in an attempt to make a sledge journey of 800 miles across the ice cap preparatory to exploring the mountain region north of Mount Forel in East Greenland.

ELEVEN fellowships in medicine, including two renewals, for study in the United States during 1934–35, were awarded at the spring meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. G. Carl Huber, dean of the Graduate School of the University of Michigan, is the chairman. The successful candidates were: Ralph W. Barris, Harold Blumberg, Dean A. Clark, Jack M. Curtis, Henry S. Dunning, Harry B. Friedgood, Benjamin F. Miller, Myron Prinzmetal, Henry G. Schwartz (renewal), Robert Tennant, William McC. Tuttle (renewal).

THE Thomas W. Salmon Memorial Committee of The New York Academy of Medicine has announced the choice of Dr. William Alanson White, superintendent of Saint Elizabeth's Hospital, Washington, D. C., as Thomas W. Salmon Memorial lecturer for 1935. Dr. White will deliver a series of three lectures on April 12, 19 and 26, 1935. His subjects will be "Psychiatry as a Medical Specialty," "The Social Significance of Psychiatry" and "The General Implications of Psychiatric Thought."

AT a meeting in memory of Dr. Linsly Rudd Williams at the New York Academy of Medicine on April 26 addresses were delivered by Dr. Bernard Sachs, president of the academy; Dr. Livingston Farrand, president of Cornell University; Dr. John A. Hartwell, Dr. Williams's successor as director of the academy, and Dr. John H. Finley, of *The New York Times*.

DR. HENRY NORRIS RUSSELL, professor of astronomy in Princeton University, lectured at the University of Virginia on the Page-Barbour Foundation, established by the late Thomas Nelson Page, on May 1, 2 and 3.

PROFESSOR HUGH S. TAYLOR, of Princeton University, on April 27 addressed the Ohio State University Chapter of Sigma Xi and the Columbus Section of the American Chemical Society on "Heavy Hydrogen and its Use as a Research Tool."

DR. THOMAS M. RIVERS, of the Rockefeller Institute for Medical Research, delivered the seventh lecture of the Harvey Society at the New York Academy of Medicine, on April 19. His subject was "Filtrable Viruses, with Particular Reference to Psittacosis."

DR. J. O. PERRINE, of the American Telephone and Telegraph Company, New York, addressed the Sigma Xi Club of Massachusetts State College on April 12 on "Researches in Speech, Music and Electricity."

DR. C. M. A. STINE, vice-president of E. I. du Pont de Nemours and Company, gave a lecture before the Franklin Institute, Philadelphia, on April 12, on "The Approach to Chemical Research Based on a Specific Example."

PROFESSOR E. K. RIDEAL, professor of colloid science in the University of Cambridge, will deliver the twenty-fourth annual May Lecture of the Institute of Metals on May 9, taking as his subject "Gases and Metal Surfaces."

IN 1933–34, for the third successive academic year, the exchange of lecturers between the departments of geology and geography at the University of Cincinnati and Northwestern University was maintained. In April Dr. John L. Rich, associate professor of geology at the University of Cincinnati, gave six lectures at Northwestern University. A similar series had been given at Cincinnati in March by Dr. Charles H. Behre, Jr., associate professor of geology at Northwestern University. Dr. Rich's lectures dealt mainly with petroleum geology and physiography, while Dr. Behre's dealt chiefly with ore deposits and structural control.

SECTION I (Psychology) of the American Association for the Advancement of Science is meeting jointly with the Western Psychological Association during the Pacific Coast meetings. The meetings are to be held on June 22 and 23 in Berkeley. Members of Section I and other psychologists are invited to attend. Correspondence concerning the meeting may be addressed to Dr. R. C. Tryon, secretary of the Western Psychological Association, University of California, or to Dr. John A. McGeoch, University of Missouri, secretary of Section I.

THE fifth annual meeting of the American Association of Physical Anthropologists will be held at the American Museum of Natural History, New York, on May 8, 9 and 10. A joint session has been arranged with the American Society of Mammalogists, who are holding their yearly meeting at the same place. An invitation has been extended by the American Society of Mammalogists to join with them in their annual dinner. This will be held at the Hotel New Yorker, on May 10.

THE Eleventh National Exposition of Power and

Mechanical Engineering will be held in the Grand Central Palace from December 3 to December 8, inclusive, during the week that the American Society of Mechanical Engineers holds its annual meeting in New York.

THE national secretaries for the United States at the First International Congress of Anthropological and Ethnological Sciences, which will be held in London from July 30 to August 4, are Professor Wilton Marion Krogman, of Western Reserve University, for physical anthropology and Professor Melville J. Herskovits, of Northwestern University, for ethnology. Inquiries concerning the details of the congress may be addressed to them.

THE Annual Congress of the South-Eastern Union of Scientific Societies will be held at the University of Reading from July 11 to 14.

THE School of Medicine of George Washington University announces recent gifts for research projects and other facilities as follows: from the Rockefeller Foundation $2,198 for research in biochemistry; from Eli Lilly and Company $1,200 for a fellowship for work on the chemistry of insulin; anonymous $1,200 for special research on endocrinology, and from Mrs. Henry Alva Strong the sum of $5,000 for additions to the Roentgen-ray department of the University Hospital.

AN Associated Press despatch reports that the Public Health Institute, to which the Rockefeller Foundation gave $1,063,000 for construction and $100,000 more for equipment, was inaugurated by Premier Mussolini in Rome on April 22. Present at the ceremony were Ambassador Breckinridge Long, of the United States, and Dr. Lewis Hackett, representative of the Rockefeller Foundation.

THROUGH an error it was stated in a recent issue that the degree of LL.D. was conferred by Stanford University on Dr. Angell and Dr. Whittaker, whereas it should have been the University of California.

DISCUSSION

TAXONOMY AS A FUNDAMENTAL FACTOR IN BOTANICAL RESEARCH[1]

A TRIANGULATION survey starts with an accurately measured base line.

Two physicists working independently on the spectrum of a substance naturally first assure themselves that the material used in the two cases is the same.

A chemist attempts to corroborate the work of another but obtains a different result. The discrepancy is explained when it is shown that in one case the material used was pure, whereas in the other case it contained a slight admixture of a foreign substance.

In general, research workers in all branches of science must, in order to compare results, base comparable experiments upon a definite or accurate foundation.

Botanical research is no exception to this general principle. What is the rôle of taxonomy in botanical science and what is the relation of taxonomic botany to other branches of botany?

It is not claimed that taxonomic botany, the classification and naming of plants, is more important than physiology, anatomy or pathology, for example, only that it is equal with them.

TAXONOMY has its own research problems, but here I shall discuss its relation to other branches of botany and shall attempt to show that it is fundamental or basic to these branches in the same sense that arithmetic is fundamental to algebra or to the calculus.

Research in most branches of botany depends for its usefulness and application on the correct identification of the species of plants investigated. If experiments upon plants are to be repeated by a second worker for confirmation of results it is necessary that the species used should be the same in the two cases. Much confusion has resulted from inattention to this seemingly self-evident truth.

Let us examine a few illustrative examples.

A cytologist investigates the chromosomes of the taxonomically difficult genus *Rosa*. How easily may his results be vitiated through lack of care in identifying the species of *Rosa* with which he works!

Experiment stations try out different samples of economic plants obtained under the same name. Differences in results may sometimes be traced to errors in identification of the material used. The Bureau of Plant Industry often imports seeds which are distributed to experiment stations for trial. Before distribution great care is taken to see that the seeds are correctly identified, otherwise the results might be of little value. Again the seeds planted may not germinate, their place being taken by other seeds already in the soil. The identity of the plants in the plots should be verified.

The ecologist deals with plant associations and often wishes to compare the floras of similar regions. Lists of plants from floral areas that are to be compared have little value unless the species are correctly identified. Species of oaks or blackberries reported under the same name from the two areas may prove when examined by a taxonomist to be different species.

A species of sandbur (*Cenchrus distichophyllus*)

[1] Read before the Botanical Society of Washington, on February 6, 1934.

endemic to western Cuba was reported from the Galapagos Islands. An examination of the specimen (sterile) upon which the statement was based showed that it belonged to *Sporobolus virginicus*, a cosmopolitan tropical coast grass. Conclusions by the ecologist or by the student of geographical botany as to the distribution of this species of *Cenchrus*, if the Galapagos specimen were included, and of tropical plants in general, would be very misleading.

The mycologist is especially dependent upon the phenogamic taxonomist for the correct identification of the host plants that support parasitic fungi. Since many parasitic fungi are very injurious to crop plants and in one of their stages may inhabit wild species, the identification of the alternative host may be of vital importance.

The same remarks may apply to the entomologist studying the life histories of insects injurious to crop plants.

The Biological Survey has made a study of the food habits of birds. Much information is derived from the examination of the contents of birds' stomachs or crops. A botanical taxonomist, expert in the identification of seeds, or an entomological taxonomist, expert in the identification of insects by means of wing cases or other hard parts, furnishes the basic information for the ornithologist. An examination of the contents of the stomachs of herbivorous wild animals will throw light on their food habits, inasmuch as the glumes or fruits of grasses, for example, being more resistant to the digestive fluids, may, when examined by a competent taxonomist, lead to the identification of the species eaten.

There is much need for expert taxonomic knowledge concerning the identity of many tropical plants that furnish important drugs, cabinet woods and other products known in commerce, but not connected with definite species. If it is desired to bring such plants into cultivation the rôle of the taxonomist becomes vital to the enterprise. We are at once reminded of the efforts to get into cultivation such plants as Cinchona and how failure has sometimes followed because the explorer did not obtain the proper species. For some years uncertainty surrounded the source of chaulmoogra oil, that from some sources being ineffective. We recall how Dr. Rock penetrated the forests of Burma and succeeded in finding the seed of the species producing the true product.

Errors in identification and the misapplication of names have sometimes led to unfortunate results.

Among parasitic fungi the specific name of the fungus is not infrequently taken from the name of the host plant. If the host has been incorrectly identified, the fungus will carry a misleading name. For example, a species of rust was given the specific name *olyrae* on the assumption that the host belonged to the grass genus *Olyra*. Dr. Arthur sent me a specimen which showed that the host was a species of the very different genus, *Arundinaria*, a kind of bamboo.

A generation ago, through some mischance now difficult to trace, Vasey grass (*Paspalum urvillei* Steud.; *P. larrañagai* Arech.), a fairly good forage grass, was introduced by the British into South Africa and Australia under the name *Paspalum virgatum*. The true *P. virgatum* L., a very coarse, bitter, razor-edged grass, called "cortadera" in the West Indies (because of its cutting leaves), is avoided by stock and is worthless agriculturally. British Colonial journals have described Vasey grass under the misleading name *P. virgatum*, causing much confusion in agricultural literature and wasted effort in obtaining seed from America.

Recently a man interested in paper-making material imported from Cuba for experiment a small quantity of *caña brava*, from which excellent results were obtained. He obtained a patent on the process and then ordered a large quantity of additional material, which proved entirely unsuited. The matter was referred to me for explanation. Specimens submitted showed that the first lot was a species of bamboo (*Bambusa*). The second lot was *Gynerium sagittatum*, a large native reed. The name *caña brava* (large or wild cane) is usually applied in Cuba to the large bamboo, but in a general way it is applied to any large wild grass. The person actually collecting the second lot had applied the name to the *Gynerium*, hence the confusion.

Taxonomists may make mistakes in the identification of plants, but these errors may be corrected if the plants upon which experiments or observations are based are preserved in a public herbarium or laboratory.

Finally, the relation of taxonomy to other branches of science may be summarized by saying that it furnishes the standard of measurement for them; or that taxonomy is to other branches of science what the dictionary is to literature, in that it enables workers to use given names in the same sense.

A. S. HITCHCOCK

BUREAU OF PLANT INDUSTRY
U. S. DEPARTMENT OF AGRICULTURE

THE EFFECTS OF X-RAYS ON PLANARIA DOROTOCEPHALA

AFTER studying the effects of x-rays on different sized populations of *Planaria dorotocephala* the following facts are evident. During the first two weeks the effects of x-rays seem to be largely of a non-specific nature in view of the fact that head forms developed resemble those induced by various depressants except for an additional type which has normal eyes

and auricles but a much shorter head than that occurring in the normal forms. This might seem to indicate that, simultaneous with the non-specific effect of x-rays upon head development, other effects, as upon cell division and growth, are occurring. As regards the non-specific nature of the more immediate effects of x-rays, it is significant that for any one dose of 4, 8 or 12 skin units the range of distribution of types regenerated increases as crowding increases.

No explanation is offered regarding the significance of the disappearance of tissue differentiated during the first two weeks. It seems to be an effect of x-rays on planarian tissue which gains expression at a period after regeneration has proceeded to its limits and which is first apparent in that region of tissue having the highest rate of metabolism.

In all x-rayed forms receiving 4, 8 and 12 skin units, the ultimate effect of x-rays is complete cytolysis. Cytolytic effects first become prominent on the thirty-fourth day after exposure. The rate of cytolysis is not greatly affected by crowding. The results of these experiments regarding the effects of x-rays are in accord with those of Bardeen and Baetjer, who conclude that x-rays affect cell division and cell differentiation and that the effects are probably confined to these two. They cite evidence from which they conclude that cell differentiation is not as much affected as cell division and that the effect upon cell division is not direct.

While both the more immediate effects and the delayed effects of x-rays may be specific upon the protoplasm, it does not necessarily follow that, because head frequency is affected by x-rays, the factors which control head frequency are specific and directly related to the activity of special formative cells. The formative cell theory of Curtis does not recognize the fact that the variation in head forms regenerated are the same type as those produced by other physical and chemical agents. It is no more necessary to assume the selective action of x-rays on formative cells than it is necessary to assume selective action of other physical and chemical agents which alter head frequency. The first apparent effects of x-rays, like various other agents, seems to be not on special formative cells but upon non-specific protoplasmic factors upon which head development depends.

Crowding varies only the rates at which effects of x-rays gain expression, allowing, in some instances, an increase in head frequency and a delay in cytolysis. As for the ways in which crowding alters these effects of x-rays on head frequency and length of life, the following possibilities may be considered: (1) Mechanical stimulation of the group upon each member; (2) a lowering of metabolic rate favoring a delay of cytolysis; (3) whatever these factors favoring group survival are, they are more effective as the dose of x-rays is increased.

The above conclusions were reached after studying the effects on over 800 Planaria.

F. G. MESERVE
MARY J. KENNEY

NORTHWESTERN UNIVERSITY

THE METHOD OF PROBITS—A CORRECTION

SINCE submitting the paper which appeared under the above title,[1] my attention has been called to recent papers by Hemmingsen[2] and by Gaddum,[3] in which substantially the same method has been proposed for toxicity tests with mice. Their "normal equivalent deviations" are measured from zero at 50 per cent. kill, taking the standard deviation as the unit, so that the elimination of a change in sign at 50 per cent. kill, as provided by the "probits," seems justified. However, the constant multiplier of 1.344447, used to equilibrate 0 and 10 on the probit scale with 0.01 and 99.99 on the percentage scale, interferes with the conversion from one system to the other. It seems desirable, therefore, to redefine the probit unit as equal to 5 plus (algebraically) the deviate of the normal curve expressed in terms of its standard deviation. As convenient sources of this deviate, either the Sheppard-Galton Table I[4] or the column of x corresponding to p and q in the Kelley-Wood Table[5] may be suggested. At 50 per cent. kill, the probit will be 5.00 as before; below 50 per cent. kill it will

TABLE I

Per cent. kill	Probits	Per cent. kill	Probits	Per cent. kill	Probits	Per cent. kill	Probits
1.0	2.674	50.0	5.000	80.0	5.842	95.0	6.645
5.0	3.355	52.0	5.050	81.0	5.878	96.0	6.751
10.0	3.718	54.0	5.100	82.0	5.915	97.0	6.881
15.0	3.964	56.0	5.151	83.0	5.954	98.0	7.054
20.0	4.158	58.0	5.202	84.0	5.994	98.5	7.170
25.0	4.326	60.0	5.253	85.0	6.036	99.0	7.326
30.0	4.476	62.0	5.306	86.0	6.080	99.1	7.366
34.0	4.588	64.0	5.358	87.0	6.126	99.2	7.409
36.0	4.642	66.0	5.412	88.0	6.175	99.3	7.457
38.0	4.694	68.0	5.468	89.0	6.226	99.4	7.512
40.0	4.747	70.0	5.524	90.0	6.282	99.5	7.576
42.0	4.798	72.0	5.583	91.0	6.341	99.6	7.652
44.0	4.849	74.0	5.643	92.0	6.405	99.7	7.748
46.0	4.900	76.0	5.706	93.0	6.476	99.8	7.878
48.0	4.950	78.0	5.772	94.0	6.555	99.9	8.090

[1] SCIENCE, 79: 38, January 12, 1934.

[2] A. M. Hemmingsen, *Quart. Jour. Pharmacy and Pharmacol.*, 6: 39 and 187, 1933.

[3] J. H. Gaddum, Med. Res. Counc. Spec. Rept. 183, His Majesty's Sta. Of., 1933.

[4] K. Pearson, "Tables for Statiticians and Biometricians. Part I," Cambridge.

[5] T. L. Kelley, "Statistical Method," Macmillan, 1923.

equal 5 minus the deviate read from one of these tables; and above 50 per cent. kill 5 plus the corresponding deviate. For convenience, these corrected probits are shown in Table I for the same percentage kills as before.

C. I. BLISS

GALTON LABORATORY
UNIVERSITY COLLEGE, LONDON

WHO'S WHO IN THE BERI-BERI VITAMIN FIELD

I HAVE been surprised and somewhat overwhelmed by the amount of publicity which our recent work on the antineuritic vitamin has had. The press has perhaps naturally ignored a great deal of other work of equal or greater importance. In the April 6 issue of the *World-Telegram* there was an editorial, the overemphasis of which upon my own achievement I have attempted to correct by writing the editor of that newspaper along the following lines:

Your editorial of April 6th on the beri-beri vitamin is one of a gratifying series of newspaper recognitions of the work of our group, Mr. R. E. Waterman, Mr. John C. Keresztesy, Miss Marion Ammerman and myself. As is probably inevitable, popular taste for a hero being what it is, the press articles have generally accorded me an over-generous share of the credit, to the detriment of this group of loyal collaborators. I wish here publicly to record their substantal part in the undertaking and our debt to Dr. W. H. Eddy of Teachers College whose interest and influence has been indispensable to success.

But I am especially concerned about your comment in that editorial on the work of Eijkman. His was an achievement of first rank. Without the experimental production of the disease in animals progress would have been impossible. While it may seem obvious now that the disease can be produced by feeding animals on polished rice, it was not obvious then. Indeed the disease he produced was not generally accepted as beri-beri for fifteen years after Eijkman's first paper. During this time his conclusions had to be reinforced by supplementary work of Pol, Grijns, Fraser, Strong, Vedder, Andrews and a score or more of others.

Notable names in the subsequent developments include Casimer Funk, a Pole, who while working in London first correctly guessed the general nature of the curative substance, Seidell of Washington, D. C., who invented the use of fullers' earth for adsorbing the vitamin, and Jansen and Donath who working in Eijkman's former laboratory in Java, first isolated small amounts of the substance and described it. Peters of Oxford, England, Ohdake of Japan, Windaus of Germany have also made important advances. I could, however, fill a column of your paper with the names of those who in various ways and in many lands have added their bits to the beri-beri vitamin problem.

Science is international. Science at its best is also a fraternity. As in other fields of endeavor, we must recognize that in reaching for our objectives we stand on the shoulders of our predecessors and companions.

R. R. WILLIAMS

BELL TELEPHONE LABORATORIES
NEW YORK, N. Y.

"WHEN THE SKY RAINS STONE"

IN the issue of *The Literary Digest* for March 17 there appears an article under the caption, "When the Sky Rains Stone." The article is presented under the name of the present writer. The facts are that the article was written by a professional magazine writer after an interview and was not seen by the present writer until its appearance on March 17.

Unfortunately the article does not in every instance present the views of the man whose name it bears. He wishes to use this opportunity for disclaiming its authorship.

H. H. NININGER

DENVER, COLORADO
MARCH 28, 1934

WHO PAYS REPARATIONS?

From time to time, in the columns of this and other journals, gentle voices of protest have been raised against the prices for scientific books charged by the German publishers. I would like to draw particular attention to the latest flagrant example of "gouging the public."

We are informed that the most recent "supplement" volume to "Beilstein" can be supplied to us at the modest price of $60.55! Since, unfortunately, "Beilstein" still remains the bible of the organic chemist, since these "supplement" volumes come out ever so often, and since one must, after all, keep up-to-date, why not charge any fancy price that you want to charge? Apparently, so argue the Germans.

We in the department of chemistry at the college have decided not to get any further volumes until the Germans cut down these "reparation payments."

BENJAMIN HARROW

CITY COLLEGE, COLLEGE OF THE CITY OF NEW YORK

REPORTS

GRAVITY STATIONS ON THE NILE DELTA

IN a report on the geodetic work accomplished in Egypt for the years 1930 to 1933, which was presented at the meeting of the International Geodetic Association held in Lisbon, Portugal, in September, 1933, is a brief account of the gravity survey that was made over the Nile Delta.

Many geologists have felt that the earth's crust is

strong enough to hold up the mass of sedimentary materials that are deposited at the mouths of great rivers. Others, especially geodesists and geophysicists, are of the opinion that the earth's crust is pressed downward by the accumulated sediments. The data for gravity stations established near the mouth of the Mississippi River indicate that the delta material for that river has pressed down the crust and that the crustal block below the delta is in approximate isostatic equilibrium. This is indicated by the small gravity anomalies based upon the isostatic theory.

It is of interest that four gravity stations were established in the spring of 1932 on the Nile Delta. The stations are:

Station	Latitude North	γ_0	Correction for height	Correction for isostasy and topography
Port Said	31° 15′	979.428	0	+.006
Ismailia	30° 36′	979.375	0	−.003
Mansura	31° 03′	979.412	−1	+.007
Damietta	31° 26′	979.441	0	+.012

The isostatic anomalies at these stations are as follows:

Station	γ (corrected)	g (observed)	$g-\gamma$
Port Said	979.434	979.448	+.014 gal
Ismailia	979.372	979.369	−.003 gal
Mansura	979.418	979.400	−.018 gal
Damietta	979.453	979.472	+.019 gal

The average of these anomalies is very close to zero, thus indicating that the crust beneath the delta must have been pushed down by the sediments unless the crust was subnormal in mass before the formation of the delta. In any event, since the anomalies are both positive and negative there is no indication that the crustal block involved is far from being in equilibrium.

It is hoped that additional gravity stations may be established on the Nile Delta in order to have further light thrown on this important subject of crustal equilibrium. It would be particularly desirable that the new stations furnish data from which one might determine the extent of the areas having positive and negative anomalies.

It would be of the greatest importance to geological and geophysical investigation if intensive gravity surveys could be made over the deltas of all the great rivers of the world. It is hoped that this work may be undertaken by the countries involved when normal economic conditions return.

W. BOWIE

AWARDS OF THE GUGGENHEIM FOUNDATION

ANNOUNCEMENT of the tenth annual fellowship awards by the trustees of the John Simon Guggenheim Memorial Foundation brings the total grants of the foundation to assist American scholars and artists to carry on research and creative work to more than $1,200,000 and the total number of fellowships awarded to 577. The names of forty Americans are on this year's list of awards. Another series of grants to Latin-American scholars will be made in June.

The foundation was established in 1925 by former United States Senator Simon Guggenheim and Mrs. Guggenheim as a memorial to a son, and its capital fund is wholly their gift. All its income is used to assist scholars and artists from the United States and certain Latin-American countries to carry on research and creative work for a period of time with complete freedom from competing interests. In making the awards, the foundation has no restrictions of race, color or creed. Men and women, married or unmarried, are eligible on equal terms. The stipends, normally $2,000 a year, are adjusted to meet the needs of the individual fellows. The periods for which the fellowships are granted vary with the necessities of the work that they have in hand. Heretofore the fellowships, which are tenable under the freest possible conditions, have been granted only for work abroad, but this year provision also is made to permit some fellows to work in the United States.

The committee of selection was composed of President Frank Aydelotte, of Swarthmore College, *chairman;* Dean Guy Stanton Ford, of the University of Minnesota; Professor Marjorie Nicolson, of Smith College; Dean Charles B. Lipman, of the University of California, and Professor E. B. Wilson, of the Harvard School of Public Health.

In fields of the physical sciences, the following grants have been made:

Dr. Robert B. Brode, professor of physics, University of California. *Project:* Research in the field of collisions of electrons with atoms, chiefly at the Cavendish Laboratory of the University of Cambridge, England.

Dr. Frank H. Spedding, instructor in chemistry, University of California. *Project:* Studies of solids at low temperatures with particular emphasis on their line-like absorption spectra, their magnetic susceptibilities, their electrical conductivities and the relations between these, in European laboratories.

Dr. Francis William Bergstrom, assistant professor of chemistry, Stanford University. *Project:* A study of the methods used in certain European institutions for the investigation of heterocyclic compounds containing nitrogen.

Dr. Kenneth T. Bainbridge. *Project:* Continuation of research in nuclear physics at the Cavendish Laboratory of the University of Cambridge. Dr. Bainbridge has recently been appointed to an assistant professorship of physics at Harvard University.

Dr. Arnold Dresden, professor of mathematics, Swarthmore College. *Project:* The preparation of a book on the calculus of variations, an attempt to unify the three points of view which are now dominant in this field, at Pisa and the Institute for Advanced Study at Princeton.

For biological investigations, the following fellowships are announced:

Dr. Harold Kirby, Jr., associate professor of zoology at the University of California, will make studies, chiefly in South Africa and Madagascar, of the Protozoa living in termites, for the purpose of contributing toward a solution of problems in the field of host-parasite relations.

Dr. George Oswald Burr, associate professor of botany at the University of Minnesota, will carry on research in the field of photosynthesis, in certain European laboratories.

Dr. Allan Lyle Grafflin, instructor in anatomy at Harvard University, will make certain investigations of kidney structures in fishes, and collect material for later detailed microscopic studies, at Naples, Italy, and Plymouth, England.

Joseph Fulling Fishman, formerly third deputy commissioner of correction of the City of New York, will shortly enter upon the fellowship previously awarded him for making studies in the field of penology abroad.

Arthur Loveridge, who is now in Kenya on a fellowship, has received a further grant to continue his ecological studies of the vanishing vertebrate fauna of the tropical rain-forest remnants of East Africa.

Dr. Michael Heidelberger, associate professor of biological chemistry at Columbia University and chemist to the medical staff of the Presbyterian Hospital, New York, will go to the University of Upsala, Sweden, to carry on researches on the molecular weight of thyroglobulin, the hormone of the thyroid gland.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

STROBOPHOTOGRAPHY IN BIRD SINGING

THE same problems of notating folk music encountered by anthropologists have been met by ornithologists in notating bird singing. The sluggishness of the ear in perceiving only gross effects, the limitations of the conventional notation system and the habit of reference to the European system of music are all opposed to finished work by both groups of scientists. As in the case of folk music,[1] the odd intervals, subtle turns, twists, intonations, quavers, trills, tremolos, slurs and unusual rhythmical and melodic performances have necessarily been passed over in the song of birds.

The application of methods of photographing auditory stimuli and a plotting of the measures on the pattern notation has revealed in a preliminary way some gratifying results in the musical performances of the nightingale, the European mocking-bird (*Hyppolais icterina*), the chaffinch (Pinzón), the garden warbler (Luruja), the canary and the canary-finch (*Fringilla-canaria*). The possibilities of this approach are illustrated in Fig. 1, representing one of the musical autographs of the European mocking-bird. This note sequence is repeated four times with little variation of each pitch pattern in the repetitions.[2]

The notes of the European mocking-bird are brief and almost continually changing in pitch, explaining why the study of intervals by ear is a difficult one. Note that the compass of the song is over three octaves.

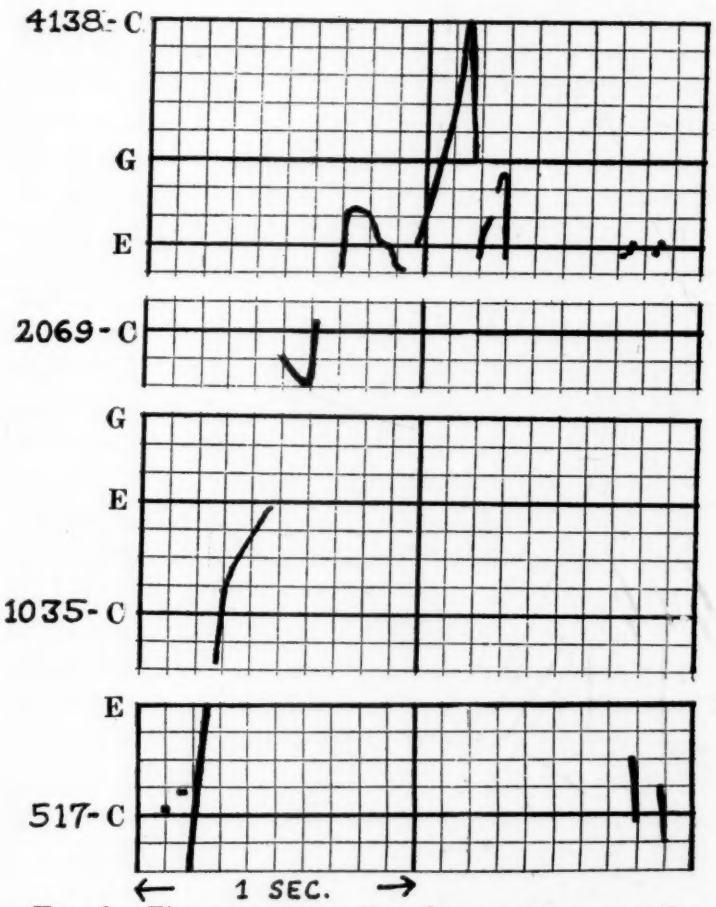

FIG. 1. The squares on the above pattern notation represent one half step (International tempered scale) vertically and one tenth of a second horizontally.

[1] M. Metfessel, "Phonophotography in Folk Music." University of North Carolina Press, Chapel Hill, 1928.

[2] The photograph was taken from Polydor phonograph record No. B–9509, with the needle placed 2 cm in from the first groove on the record.

This pattern notation was secured by photographing the sequence on the strobophotograph.[3] It automatically plots a pitch graph on a vertical measure of 1 cm for each half-step of the tempered musical scale, and a horizontal measure of 50 cm for each second. The phonograph record is played at 15 r.p.m. Fig. 1 is a transposition from the strobophotographic record to a more condensed type of pattern notation.

In this writing it is possible only to mention a few of the effects now photographed:

(1) The predominance of bird notes between 2,500 dv. and 4,000 dv. suggests the frequent use of the vowels in *seat* and *sit* in syllabifications of bird music. Resonance regions of these vowels are generally found between these pitches. There are no vowels in bird song, but the vowel-like character of pure tones at the pitches of the resonance regions has been known to psychologists from the early work of Köhler.

(2) The rapid chirps of the canary often are timed so as to produce a decreasing curve of rate resembling that of muscular fatigue. In a typical case, the chirps begin at a rate of 27 times per second. Each chirp is a discrete unit, a starting and stopping of the note. The chirps come in rhythmical groups of two on approximately the same pitch, the first of each pair being more intense and slightly longer in time. They drop off in rate to three per second during the seventh second. In the sixth second the chirps become trill-like, and in the seventh they change to tones with a falling inflection of about a half-step. Other variations of the pitch patterns of the canary chirps have been isolated. There is the slurred chirp on two notes a little more than three half-steps apart, and the single rapid chirp with a falling inflection of but a half-step. Most of the chirps at the beginning average .025 sec., with the pause between chirps as short as .01 sec. Such performances are impossible by human voices or whistles.

(3) Likewise the rapidity of the trills and warbles are beyond human duplication. The typical warble of the garden warbler has a rate of 50 per second and a rise and fall extent of more than a whole-step. Other warbles of the same bird reveal a rate of 70 per second and extent averaging a half-step. Especially interesting is the double-note of the garden warbler, in one instance with two separate and simultaneous pitches sounded 260 dv. apart, and producing fluctuations at that rate. Another case reveals beats 30 times per second. These would be heard as warbles, but the warble is a rise and fall of successive pitches on the scale, rather than two simultaneous pitches.

A typical trill of the nightingale has a rate of 60 cycles per second and about .5 step in extent; that of the European mocking-bird a rate of 30 per second and an extent of between 1 and 1.5 steps. The human trill is about 7 times per second, with an extent averaging 1.25 step. Some tremolos reach a rate as high as 14 per second, which is likewise the warble rate limit of bird imitators. One of the warbles of the European mocking-bird has an average extent of 1.8 steps and an average rate of 5.5 per second. Such a slow rate is a rarity.

(4) The interplay of noises with tones is an important charactersitic of the birds thus far studied. The general pitch level of the noises is ordinarily between 500 dv. and 1,500 dv.

(5) The "burring" of tones is frequently noticeable. ("Burring" resembles human humming and whistling at the same time.) It is different from the beating effect of the garden warbler in that the "burring" involves notes in the low and high registers, often 2,000 dv. apart.

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[3] *Cf.* two articles by the writer: (1) "A Photographic Method of Measuring Pitch," SCIENCE, 68: 430–432, 1928; (2) "The Strobophotograph," *Jour. Gen. Psychol.*, 2: 135–139, 1929.

THE PURE CULTURE OF PARAMECIUM

THE need for a uniformly multiplying culture of animal cells in the absence of bacteria and other kinds of life has long been felt. The efforts to obtain *Paramecium* in pure culture have been particularly numerous, but the first reported success, by Glaser and Coria,[1] has only recently appeared. Since this work, describing the pure culture of *Paramecium caudatum,* has not been confirmed, their experiments were repeated in an attempt to verify the results.

Glaser and Coria developed an enormously complex medium consisting of liver extract, yeast cells and fresh rabbit kidney. The liver extract (0.5 per cent. Eli Lilly Company's No. 343) was passed through a bacteriological filter. To this filtrate, yeast which had been killed at 75° C. and pieces of kidney from a freshly killed rabbit were added, using aseptic precautions. The paramecia were washed through tubes of sterile medium in order to remove bacteria. From inocula of as many as 870 of these ciliates per 10 cc of the medium, luxuriant growth was obtained. Tests with the usual bacteriological media indicated sterility. Microscopic examination revealed small rods with a superficial resemblance to bacteria, but which, in the opinion of these authors, were "cilia torn from the Paramecia."

The author repeated this work, following the method of Glaser and Coria as closely as possible,

[1] *Jour. Parasit.*, 20: 33, 1933.

except that the paramecia were taken from a culture containing a single strain of bacteria, *Achromobacter pinnatum,* and were washed according to the method of Parpart. This bacterium is extremely easy to remove, so it was possible to sterilize large numbers of the ciliates. The following results were obtained. The sterile 0.5 per cent. liver extract killed *P. caudatum* in about one hour. After the yeast suspension and kidney were added, a marked reduction in toxicity was evident. If only a few paramecia were inoculated, survival continued for about three hours. If a large number, *i.e.,* 100, was inoculated, a few lived six to eight hours. If a similar number was added with a few bacteria, some of the paramecia survived and started to increase.

These results were checked, using other ciliates, some of which the author had previously obtained in pure culture. The small and resistant *Glaucoma piriformis,* when taken from a pure culture and added to the liver extract, largely subsides in six hours, but a few swim about for twelve hours. *Colpidium campylum* is slightly less resistant. *Colpidium colpoda,* on the other hand, behaves like *Paramecium,* for it is killed even in the complete medium in a few hours. Since these relatively resistant ciliates are killed by the medium, it is improbable that it is well suited to *Paramecium.*

The most difficult bacteria to remove when washing ciliates are certain slow-growing, adherent forms of very deceiving nature. Peters found that what he first interpreted as "patches of cilia" in his cultures on ammonium glycerophosphate were bacteria and that the growth of *Colpidium* was due to these bacteria. Hetherington[2] repeated these experiments and obtained the same results.

It is instructive to note the characteristics of these bacteria: (1) They are killed at 37° C.; (2) they grow very slowly—colonies on nutrient agar plates are easily overlooked on the third day of incubation at 25° C. and are still very small on the fourth; (3) they do not cloud liquid media even after considerable periods; (4) they are remarkably adherent, usually appearing affixed to the slide or cover-slip in somewhat uniform rows.

These facts suggest that Glaser and Coria probably did not have sterile paramecia.

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A HOLDER FOR SMALL ANIMALS

THE following animal holder is being offered as a result of our effort to secure a holder that is not only practical but also simple and inexpensive. Because of its ease of adjustment it is suitable for all small animals, including cats and small dogs. Notwithstanding its simplicity, it permits the arrangement of the animal in the position most satisfactory for any procedure. In general, its design follows that of the holder for chickens developed by Seifried, Cain and Wulf.[1]

The board consists essentially of a metal plate (A) 28 inches long and 5½ inches wide mounted on six-inch legs (B) (Fig. 2) to form a table. The upper

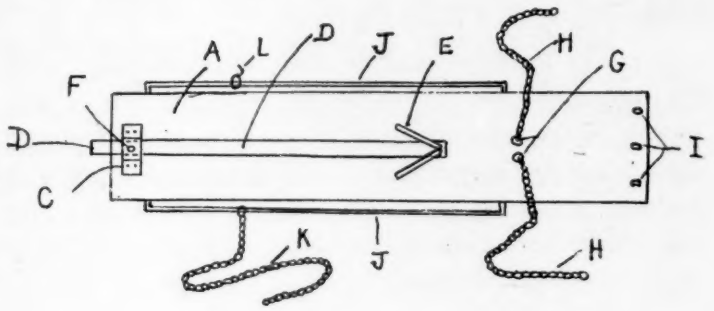

FIG. 1.

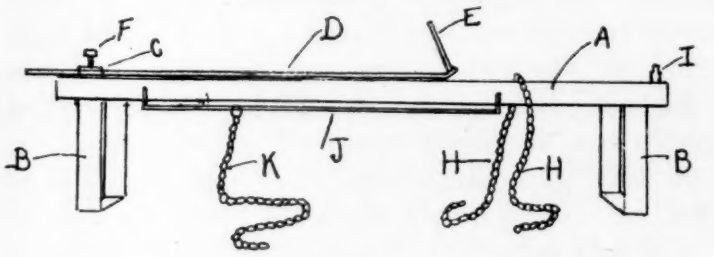

FIG. 2.

surface of the plate is slightly depressed longitudinally down the center to fit the spine of an animal in a dorsal position. At one end and on top of the plate is a bracket (C) carrying a sliding bar (D), to which is attached a forked head holder (E). After adjustment to the length of the animal, the bar, together with the head holder, is locked into position by the set screw (F). The forked head holder is set at an angle of approximately 30 degrees from the vertical as an added safeguard against the animal lifting its head. Coming through two small holes (G) in the plate seven inches from the opposite end from that carrying the bracket are two lengths of light chain (H), permanently fastened to the under side of the plate, for crossing diagonally over the hind legs and then being attached to the pins (I) at the end of the board. On each side of the board are welded two rods (J), extending slightly down and out from it and running from the position of the bracket down about three quarters of the length. Attached to one of these rods is another length of chain (K) and to the other a hook (L). Both the chain and hook are so attached to the rods that they may slide along them. The purpose of this chain is

[1] Oskar Seifried, C. B. Cain and Harro Wulf, SCIENCE, 75: 1942, March 18, 1932.

[2] *Arch. Protistenk.,* Bd. 80: 255, 1933.

to pass over the upper part of the body and when tightly fastened to the hook it restrains any motion of this part of the body.

When the animal is properly stretched out before securing the three chains in position the animal is completely restrained and very little, if any, movement is permitted except by the fore paws.

The advantages of this holder appear to us to lie in its compactness, simplicity and utility with a minimum number of adjustments or attachments.

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THOMAS DURFEE
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PRINCETON, N. J.

SPECIAL ARTICLES

THE VIRUCIDAL ACTION OF HIGH FREQUENCY SOUND RADIATION[1]

THE effect of high frequency sound radiation on biological material was first studied by Wood and Loomis.[2] Since the publication of their investigations in 1927 considerable work dealing with this phenomenon has followed. Much of the literature on this subject has recently been reviewed by Chambers and Gaines.[3] In our experiments we have determined the effect of such high frequency sound on tobacco mosaic virus.

The apparatus used by us was similar to that described by Harvey, Harvey and Loomis.[4] In brief, the sound radiation originated in the vibration of a one-inch-square quartz crystal immersed in a water-cooled, circulating oil bath and excited by means of a 75-watt vacuum tube oscillator in connection with a step-up voltage arrangement. The natural frequency of the crystal was 450,000 cycles per second.

Leaves from tobacco plants affected with the virus of typical tobacco mosaic were crushed, frozen overnight and thawed, and the juice was pressed from the tissue and centrifuged. Three cubic centimeters of juice were then pipetted into a small test-tube, the end of which had been blown into a thin-walled bulb about one inch in diameter. The bulb was immersed in the oil bath directly above the quartz crystal. Separate samples from the same lot of juice were irradiated for 30, 60 and 120 minutes. The temperature of the liquid within the bulb immediately after each experiment was found to have risen from 24° C. to approximately 35° C.

It was shown by a test that this rise in temperature during the course of the experiment was not a factor in the inactivation of the virus. The total number of local lesions formed on 20 half leaves of *Nicotiana glutinosa* inoculated as described below was 1,052 for juice held at 35° C. and 1,058 for unheated juice.

After each experiment the juice treated with sound radiation and the untreated controls were diluted with distilled water, as indicated in Table 1, and were used to inoculate opposite halves of leaves of *Nicotiana glutinosa,* according to the method devised by Holmes[5] and Samuel and Bald.[6] The number of local lesions produced on the leaf halves gives an indication of the relative concentration of active virus present in the suspensions.

TABLE 1

THE INACTIVATION OF TOBACCO MOSAIC VIRUS BY HIGH FREQUENCY SOUND RADIATION

Number of experiment	Duration of experiment, minutes	Number of local lesions per 20 half leaves of *Nicotiana glutinosa* inoculated with juice diluted 1:500, except as noted	
		Untreated juice	Juice treated with sound radiation
1	30	980	50
	60	1,446	9
	120	872	0
2	30	1,301	584*
	60	1,218	52*
	120	1,116	0*

* Diluted 1:50.

The results obtained indicate that the tobacco mosaic virus is inactivated by high frequency sound radiation. A progressive inactivation of virus with time of exposure was found to take place. After exposing the juice for two hours the presence of active virus could not be detected by inoculating

[1] A joint contribution from the Division of Plant Pathology and the Fruit Products Laboratory, University of California.

[2] R. W. Wood and A. L. Loomis. "The Physical and Biological Effects of High Frequency Sound Waves of Great Intensity," *Phil. Mag.*, 4: 417–436, 1927.

[3] Leslie A. Chambers and Newton Gaines. "Some Effects of Intense Audible Sound on Living Organisms and Cells," *Jour. Cell. and Comp. Physiol.*, 1: 451–471, 1932.

[4] E. N. Harvey, E. B. Harvey and A. L. Loomis. "Further Observations on the Effect of High Frequency Sound Waves on Living Matter," *Biol. Bull.*, 55: 459, 1928.

[5] F. O. Holmes, "Local Lesion in Tobacco Mosaic," *Bot. Gaz.*, 87: 39–55, 1929.

[6] Geoffrey Samuel and J. G. Bald. "On the Use of the Primary Lesions in Quantitative Work with Two Plant Viruses," *The Annals of Applied Biology*, 20: 70–99, 1933.

leaves of *N. glutinosa*. The results of five other experiments showed a similar inactivation.

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THE ETIOLOGY OF A RESPIRATORY DISEASE OF CHICKENS

THE occurrence of a severe type of respiratory infection in chickens, which was believed to be distinct and previously undifferentiated, was observed by Pistor, Hoffman, Beach and Schalm[1] in California early in 1933.

The disease is easily transmitted either by inoculation with exudative material or by contact exposure. In either case a nasal discharge develops which is followed by an edematous inflammation of the periorbital tissues, a purulent conjunctivitis and often a distention of the sinuses of the head with exudate. The infection may spread to the trachea, bronchii and lungs, causing rales, dyspnea, coughing, and sometimes death from suffocation. Infection by contact exposure may start as a tracheitis and bronchitis. The appetite diminishes or ceases with the onset of symptoms, resulting in a rapid and extreme emaciation. If the affected fowl does not die in the early stages of the disease, the edematous swellings of the head and the distention of the sinuses soon disappear, but a nasal discharge and a mild conjunctivitis and tracheitis may persist for many days, and finally the fowl may die in a greatly emaciated state or recovery may slowly occur.

Smears of the various exudates stained by Giemsa's or by Gram's method have quite consistently shown the presence of small bacilli, which vary in length and stain, in the majority of cases, only at the poles. This organism is not typical of the pasteurella group. Another organism, a vibrio, is also consistently found, sometimes in great profusion, in the nasal, conjunctival and tracheal exudates but not as yet in the edematous exudate.

The various exudates have been streaked on plates of the common culture media, including horse-blood agar plates which have been incubated aerobically, in an atmosphere containing 10 per cent. CO_2 and also sealed with modeling clay, the method which Nelson[2] found suitable for cultivating the causative organism of a coryza of chickens. Growth of an organism pathogenic for chickens has been obtained only on the blood agar plates incubated in an atmosphere at 10 per cent. CO_2. On such plates there has appeared, often in pure culture, very small (pinpoint) discrete colonies, which, when washed off and inoculated intranasally and intratracheally into susceptible chickens, from 6 weeks to six months old, have in 45 out of 48 cases produced symptoms varying from a slight nasal discharge to all those observed in fowls inoculated with exudate.

The incubation period of the culture-induced disease varies from 15 to 48 hours, which is the same as observed in the exudate-induced disease. Smears of the various exudates of the culture-induced disease have consistently shown the presence of the bacillus but never the vibrio. The duration of the disease induced by culture has varied between 2 and 22 days, a much less prolonged course than in exudate-induced infection.

The organism appears to belong to the class of hemophilic bacteria, for attempts to grow it in the absence of hemoglobin have been unsuccessful, and the influence of the "V" factor on its growth is readily observed on contaminated plates by the larger size and greater opacity (satellite phenomenon) of the colonies nearest the contaminant. In smears made after 24 hours incubation, the organism is found to be a small Gram negative rod, which has a tendency to form long filaments; after 48 hours' incubation, a few fragments and single rods, but rarely filaments, are observed and, after incubation for 60 or more hours, only fragments of indefinite shape, which stain faintly, are found. Transfers made after the organism has fragmented give rise to rods and filaments again in the transplant. The pathogenicity of the organism is not affected by the fragmentation. Polar staining of the organism in cultures has rarely been observed, but lightly stained areas are commonly seen in the filaments. The organism has grown aerobically in horse serum at the base of blood agar slants, and after prolonged incubation slight colonization has occurred on the surface of the slant.

The vibrio has grown in the horse serum at the base of blood agar slants, but up to the present time has not been isolated in pure culture. Until this is accomplished, it will be impossible to conclude whether it is concerned in the etiology of the disease.

Fowls after recovery from exudate-induced disease have reacted in a variable manner to subsequent inoculation with exudate; some have been refractory, while others have shown no resistance other than that the disease produced was less severe than that in the controls. Fowls that have recovered from culture-induced disease have, in 8 of 10 trials, proved refractory to a subsequent inoculation with cultures. Such fowls, however, have been susceptible to inoculation with exudate, although the resultant disease has been less severe than that in the controls, and, with one exception, edema of the periorbital region has not occurred.

The failure of infection with the organism to immunize against the exudate is not regarded as indi-

[1] W. J. Pistor, A. H. Hoffman, J. R. Beach and O. W. Schalm, *Nulaid News*, 11: 7, 1933.
[2] J. B. Nelson, *Jour. Exp. Med.*, 58: 289, 1933.

cating that the organism is not the etiological factor in the exudate, because the infection with the exudate itself did not always protect against reinjection. It seems more logical that the pathogenicity of the organism has been reduced by cultivation so that it is incapable of producing a high degree of immunity.

The clinical manifestations of the disease under discussion closely resemble those described by Delaplane, Stuart and Bunyea[3] of a similar disease of chickens in Rhode Island and it seems not unlikely that the two may be identical. There are also points of similarity between the disease and the coryza studied by Nelson,[2] particularly his type III. The organism that has been isolated and which is believed to be an etiological factor of the disease appears to differ in some aspects from the one identified by Nelson[2] as the cause of a coryza of chickens. Further studies, however, may show that the two belong to the same species.

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THE TREATMENT OF DECIDUOUS FRUIT TREES AND NUT TREES INFECTED BY PHYMATOTRICHUM OMNIVORUM WITH AMMONIUM COMPOUNDS

THE disease known as cotton (or Texas) root-rot causes serious losses in most of the dicotyledonous crop plants grown throughout its rather restricted range in the semi-arid Southwest. One of the most serious aspects of its depredations is the destruction of many valuable long-lived perennials, such as deciduous fruit trees, nut trees and ornamental trees and shrubs. The root-rot fungus persists in the soil and, starting from one or more points in the orchard, advances in ever-widening circles until the whole planting has been destroyed. Rotation with resistant or immune species, the most successful method of control in case of field crops, is not practical in the case of tree crops.

For the past five years the author has been experimenting with visibly infected trees, using a variety of chemical and other treatments. Many of the early results were not particularly encouraging, as the root system of attacked trees is usually very seriously damaged before symptoms are clearly visible in the foliage. Some promising treatments have proven disappointing in the field because the chemicals used were too active when applied to our soils and quickly became converted to relatively insoluble and innocuous forms.

Results of the past two years, however, indicate that two of the treatments will prove successful in checking and overcoming the ravages of root-rot in some tree crops. Whether they will be effective in case of our most susceptible trees remains to be seen. The two treatments which have proven most successful are rather heavy applications of ammonium sulfate or ammonium hydrate diluted to a safe concentration with water. Ammonium hydrate was reported by Neal *et al.*[1] to be successful in killing the root-rot fungus without killing the host plant (cotton). Various workers have tried different nitrogenous commercial fertilizers in moderate amounts without finding any definite benefit.

Since both chemicals, especially the hydrate, are very toxic to the trees if applied in too great a concentration, a special method was evolved for the safe and accurate applications of these chemicals under field conditions. The choice of these two chemicals seems particularly fortunate, as they are relatively inexpensive and easily obtained, and both leave a large residue of quickly available nitrogen in the soil, for nitrification of the ammonia in either case is well advanced in three or four weeks. The strong stimulating effect of the nitrogen appears to be essential to recovery, as trees visibly affected by root-rot have greatly weakened and decayed root systems, which must be quickly replaced if the tree is to survive. The ammonium hydrate has proven somewhat disagreeable to handle on account of its volatile nature, but it is perhaps somewhat better for treating very badly diseased trees.

The outstanding success has been in treating affected pecan trees in the Yuma Valley. Pecan trees are usually visibly affected a year before they die from root-rot, while deciduous fruit trees often succumb without warning. The largest number of the treated trees were in two orchards. In the first orchard no treated trees were lost; in the second grove about 40 per cent. of the treated trees died, but many of the others showed great improvement. The higher mortality is accounted for by the fact that the very worst trees were chosen for treatment and the general condition of the grove was less favorable. Experiments on deciduous fruit trees in Yavapai County (altitude 3,000 to 3,500 feet) have been complicated by the great variability of the orchard soils of that district and the difficulty of treating a sufficient number of affected trees to secure reliable data, but results have been mainly encouraging.

While experiments have been conducted largely with badly diseased trees, it is obvious that the effect of treatment should be much more valuable to the commercial grower if applied to trees only slightly affected or standing in the path of the advancing

[1] D. C. Neal, R. E. Wester and K. C. Gunn, "Treatment of Cotton Root-rot with Ammonia," SCIENCE, n. s., 75: 139–140, January 29, 1932.

[3] J. P. Delaplane, H. O. Stuart and H. Bunyea, *Jour. Amer. Vet. Med. Assoc.*, 82: 772, 1933.

fungus. Such trees might be maintained without loss of production, while badly diseased trees must usually be severely pruned to balance the top and the weakened root system.

A detailed account of these experiments will be published.

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A GENETIC STUDY OF CEREBRAL ACTION CURRENTS

ONE thousand, one hundred and ninety-five action currents were obtained from the fore- and mid-brains of the crayfish, frog, snake, pigeon and the rat, by using five stages of vacuum tube amplification, an oscillograph and motion picture film. The animal's brain was exposed under a local and general anesthetic and electrodes fixed on the surface of the brain. The recording was made with the animal well out from under the general anesthetic.

The records were taken from all the main portions of the fore- and mid-brains of the five animal groups under diverse visual, auditory, tactual and pain stimulation and with the animal making "spontaneous" body movements. Care was taken to select stimuli which would produce comparable behavior in the various animal groups. The records were classified with respect to the type of stimulus, the response of the animal, the location on the brain, the amplitude, wave-form and gross pattern of the impulses.

A comparison of the various animal groups leads to the following conclusions: First, all the evolutionary stages are alike in that the activity of the brain under a given stimulus-response condition is differentially distributed over a wide area in the form of a gradation of intensity, or amplitude, and extent of impulses. In no case did a single area or region function alone under a given type of stimulation and response of the animal, even in the case of the eyelid reflex. This fact finds substantiation in Lashley's theory of mass action. Second, in the lower animal forms, the gradients extending across the brain are more unstable than in the higher forms and in fact seem to vary in chance fashion under the same stimulation and response. This fact is consistent with the greater equipotentiality of structure found in the lower animal forms. Third, in the more developed animal forms, under motor activity, the brain exhibited in general two major loci or peaks of nerve potential, one in the motor region and one in the visual region, with gradations toward lower potentials between the anterior and posterior poles. A gradient appeared under visual stimulation, with its peak at the posterior pole. Under sound stimulation a lateral gradient appeared.

Fourth, there was a greater homogeneity of brain function in the lower animal forms, so much so that in many cases the gradient was hardly perceptible. This fact suggests less resistance to spreading in the less differentiated brain. In general, for any given stimulus-behavior situation, the lower the animal form the wider the brain area measurably involved and at the same time the more homogeneous the disturbance. As the animal brain differentiates it takes on greater specialization of function observable in sharper and more definitely outlined gradients, *but the mass is still relevantly involved in all stimulus-situations.* Fifth, in all the behavior situations, except spontaneous activity of the animal, the magnitude of the brain disturbance decreases in the higher animal forms, a fact probably related to the greater mass of the forebrain, which, because of its mass, may exhibit a shunting effect on incoming disturbances. The greater structurization with respect to particular stimulus-patterns is also a probable factor. Cortical evolution may be described as the achievement of that differentiation of structure which protects the brain against the more excessive and more homogeneous expenditure of energy found in the lower forms. Sixth, the only condition found under which activity increases as one proceeds up the animal scale is that of "spontaneous" activity. As the brain differentiates those same patterns of energy which became more structured from the standpoint of outside disturbance function for increased "spontaneous" response. From the standpoint of intensity the large brain mass in the higher animals is more significant for aggressiveness than for fine degrees of sensory differentiation.

Seventh, in the lower forms the brain was involved homogeneously at a maximum level even with the eyelid reflex, while with spontaneous activity the level of potential was very low. Simplicity of integration would seem to depend on wide-spread homogeneity of potentials. The differential necessary for a simple reflex means, *in the more complex brain,* a greater expenditure of energy in delay and in resistance to outside disturbance. Eighth, the greatest magnitude of brain disturbance occurred under pain stimulation. Ninth, it was evident throughout that the different parts of the brain subserve different functions at different times. A sharp distinction between sensory and motor regions seems no longer justified. In general, the results support a dynamic field-theory of brain activity, rather than a mechanistic, summative theory.

Further work is in progress on all the points suggested.

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THE SCIENTIFIC MONTHLY

EDITED BY J. McKEEN CATTELL

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SCIENCE NEWS

Science Service, Washington, D. C.

HEAVY HYDROGEN

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DIRECT proof of the synthesis of matter has been brought to light by the discovery of a new heavy, heavy hydrogen atom of mass three. The discovery resulted from experiments conducted by Professors Gaylord P. Harnwell, Henry D. Smyth and Walker Bleakney, all of the department of physics of Princeton University.

Through these experiments there have been found minute traces of this very heavy variety of hydrogen of mass three in a sample of almost pure hydrogen of mass two supplied by Professor Hugh Taylor, of the department of chemistry. This was accomplished by using a mass-spectrograph of very high sensitivity recently constructed in the Palmer Physical Laboratory at Princeton. This apparatus is capable of detecting one part of hydrogen of mass three in a million of mass two and in the sample analyzed actually recorded one part in two hundred thousand.

This experiment has served to prove the existence of this third isotope of hydrogen in a stable form in nature and has given an estimate of its abundance. Apparently it is present to less than one part in a billion of ordinary hydrogen.

Lord Rutherford and his associates at the Cavendish Laboratory in Cambridge, England, have obtained evidence that when two atoms of heavy hydrogen, which have a mass of twice that of ordinary hydrogen, strike one another with sufficient energy a process of atomic transmutation takes place. These two atoms of mass two probably coalesce into an unstable atom which flies apart, not as the two atoms of mass two, from which it was formed, but as one atom of mass one, which is ordinary hydrogen, and one of mass three, which is a variety of hydrogen heavier than any previously known. The evidence for the existence of this third very heavy hydrogen has been of extremely indirect nature until the completion of these experiments at Princeton. An experiment of the same nature as that of Lord Rutherford's has been performed by Professors Harnwell and Smyth. Some hydrogen of mass two was bombarded for a considerable time by more of the same hydrogen and later the resultant mixture drawn off and analyzed in the mass-spectrograph by Dr. Bleakney. It was found that after this process the ratio of hydrogen three to that of hydrogen two had increased from the original ratio of one part in two hundred thousand to about one part in five thousand. The only adequate explanation appears to be that the transmutation process postulated by Lord Rutherford actually occurs.

This recent experiment is the first instance where any atomic species has been produced artificially in sufficient quantity to analyze and detect by other than radioactive means. The continuation of this work is being undertaken by Professors Harnwell and Smyth with the purpose of producing larger quantities of this heavy hydrogen and of attempting to detect by the same method a second possible variety of helium of mass three instead of the ordinary sort with mass four. Dr. Bleakney reported the discovery to the American Physical Society meeting at Washington.

The positive discovery of the third kind of hydrogen, 300 per cent. as heavy as the ordinary kind, will rank with the discovery in 1931 that there is a double-weight hydrogen, named deuterium.

PENETRATING RAYS FROM THUNDER-CLOUDS

PENETRATING radiations resembling cosmic rays, but "softer," are thrown upward into the air from the tops of thunderstorm clouds, like spray from the tops of waves. They come to earth again to the eastward of the cloud, drawn down by the earth's magnetic field.

These radiations, which are made up of speeding negative electrons, were described before the meeting of the American Geophysical Union by Dr. B. F. J. Schonland, of South Africa, who is visiting in the United States.

Dr. Schonland states that when he began his investigations of penetrating radiations caused by lightning, he supposed that he would find electrons poured directly earthward as well as upward into the higher levels of the air; but this proved not to be the case. He has found that lightning-engendered radiations can influence cosmic-ray detecting instruments as much as a thousand miles away from a thunderstorm, and he stated that another investigator claims for them an even greater radius of action. But their effect is always felt to the eastward of the storm that gives them birth, never toward the west.

The research was undertaken with the idea of finding out whether cosmic rays were entirely the product of thunderstorms, as one student of the subject had claimed. Dr. Schonland is convinced that this is not the case; nevertheless, there are enough lightning-caused penetrating radiations to make it necessary for investigators of cosmic rays to take them into account, if their figures are not to be falsified.

THE RELATIVITY AND QUANTUM THEORIES

THE unification of the relativity theory and the quantum theory was the subject of a lecture by Sir Arthur Eddington to the National Academy of Sciences. He took the universe as pictured in formulae by Einstein and others, himself included. He took the mathematical picture of the sub-atomic world of the quanta. He brought them together.

According to Sir Arthur, it is difficult, nearly impossible, to put what he has done into words. It is a matter of expressing the constants of the universe and of gravitation in terms of the electric charge and mass of the electron. The mathematical language of astronomy is translated into the language of sub-atomic physics.

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The increasing interest in the more exact study of the functions of carotene in mammals accentuates the importance of the availability of a dependable supply of carotene of the highest purity. This interest is not only in the function of carotene as a provitamin, but also in its importance in other directions, particularly the importance of the maintenance of an optimum blood carotene level.

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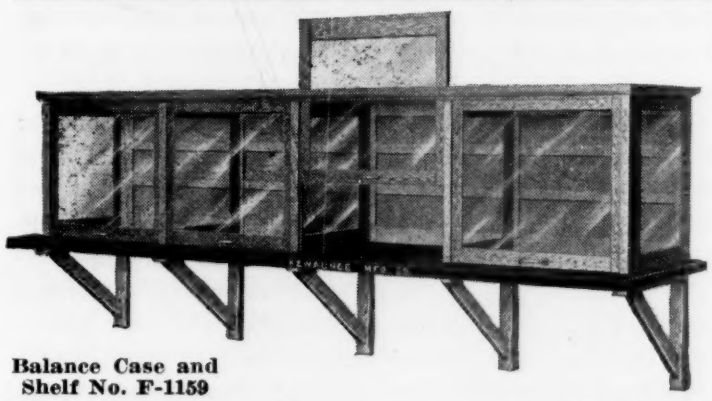

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One of the strange ideas used is that in the universe of relativity mass is associated with the curvature of space and that in a flat, purely Euclidian space there would be no mass or matter. To get at the mass in the realm of the quantum theory, Sir Arthur used what he called a "short cut." He determined the mass by means of the use of the famous uncertainty theory, which says that the mass of a particle can be known only if there is uncertainty about its position.

There is a limit to the uncertainty of the position of a particle in the universe even if it is totally unknown. As an analogy he pointed out that the authorities might know absolutely nothing about where an escaped criminal is located, but they can locate him within some 12,000 miles because he must be on the surface of the earth. So Sir Arthur locates the particle whose mass is desired as somewhere in the universe, with a certainty of a few thousand million light years. With this limit to the uncertainty he is able to derive without the aid of experiment values of the electron and proton that agree closely with those obtained by experiment.

The electric charge on these particles originates in the division of the universe's mass into a large number of particles, Sir Arthur explained. The charge comes when there are at least two particles and it can not exist when there is only one.

There is one incidental philosophical observation from Sir Arthur's uncertainty procedure: "You can not produce complete ignorance."

The numbers 136 and 137 bob up in the intricate equations as specially significant and interesting numbers. They are expressions of the degrees of freedom involved, the ways that things can be considered and arise from out of the properties of the particles.

Sir Arthur gave credit to Professor P. A. M. Dirac, of England, and Dr. Hermann Weyl, now at the Institute for Advanced Study, Princeton, for their work upon the problem of uniting the relativity and quantum theories.

PROTECTION AGAINST PARROT FEVER

THE heroic sacrifices of life and health made by workers in medical laboratories throughout the world have aroused universal sympathy and admiration. News that the hazards faced daily by these men and women are gradually being lessened is particularly heartening.

The latest achievement in this direction is protective vaccination against psittacosis or parrot fever, just announced by Dr. Thomas M. Rivers, of the Rockefeller Institute for Medical Research in New York City.

Seven laboratory workers have already been vaccinated. Five or six doses of live virus varying in strength from 10,000 to 10 million times the dose that will kill a mouse were injected into their muscles in order to establish in these workers a resistance to the dangerous organism which causes the disease.

Parrot fever has been particularly hard on laboratory workers who promptly met the challenge of this new and mysterious malady when it broke out all over the world in 1929, following the distribution of diseased parrots from Argentina and Brazil in that year.

Eleven cases developed at the U. S. Public Health Service's National Institute of Health in Washington. Nearly twenty more have been reported from laboratories throughout the world. The valiant work of these and other investigators has enormously increased the scanty knowledge of the disease held prior to 1929.

Now as a crowning touch comes vaccination against it for the laboratory workers, at least. With protection achieved for these key men in the fight against the disease, means of protecting the rest of the population, particularly bird-fanciers, pet-owners and pet-shop salesmen who are most exposed to the danger, may be expected to follow soon.

It is not so long since vaccination against dreaded yellow fever was achieved by Dr. W. F. Sawyer and associates of the Rockefeller Foundation. As a result, the group of men and women investigating this disease in its tropical breeding places, and also explorers, missionaries and others whose busines takes them to the yellow fever zones of the world may be assured of protection.

Rocky mountain spotted fever is another highly fatal malady that has taken a high toll among laboratory workers. Protective vaccination against this has been achieved by officers of the U. S. Public Health Service. Here, as in the case of yellow fever, and presumably psittacosis for the present, vaccination of large populations is not practicable but at least those most in danger of contracting the disease in the course of their daily occupations may be protected.

CLIMATE AND CULTURE

SEA-TEMPERED winds from the cool northwest hold people to a high level of efficiency, make for rapid reproduction and stimulate ambition.

Climates like those of the sea-fronting nations of northwestern Europe, and of the northeastern United States and the Puget Sound region, were held up as best for the development of a high civilization by Dr. Ellsworth Huntington, research associate in geography at Yale University, in an address before a sectional meeting of the American Chemical Society.

"The best condition for man is summer weather with an average day and night temperature of about 64 degrees, which means up to 70 or more by day. This is the best temperature for physical health. Although we are unconscious of it, the birthrate shows that reproduction takes place more rapidly at this temperature than at any other.

"But among people who live as we do, mental activity is greatest when outdoor temperature averages much lower. Even though we work indoors, the outdoor temperature affects us so that we work best in weather averaging about 38 degrees, that is, when there are mild frosts at night.

"Temperature is by no means the only factor in producing the climatic optimum. We need plenty of atmospheric humidity except at high temperatures. Then, too, we also need plenty of variability from day to day, although great extremes are not desirable.

"It is perfectly possible that some day the progress of invention will cause a still colder climate to have the

most stimulating effect. Or perhaps a new knowledge of how to create the right conditions in tropical countries may make the warmer regions far more stimulating and healthful than is now the case. Nevertheless, for the present there is no reason to think that there will be any radical change.''

THE THYROID GLAND AND ITS PART IN HEART DISEASE

THE pain of angina pectoris and congestive heart failure may be relieved in some patients immediately after operation for complete removal of the normal thyroid gland, Dr. H. L. Blumgart, of Harvard Medical School and Beth Israel Hospital, Boston, reported at the meeting of the American Society for Clinical Investigation.

Surgeons should not be misled by this immediate relief of pain, since its cause is temporary. Permanent relief is not possible until there has been time for the metabolic rate to be reduced as a result of removal of the thyroid.

This now famous operation was devised by Dr. Blumgart and Drs. S. A. Levine and D. D. Berlin to lessen the load of the overworked heart or weakened arteries in pumping and carrying the mass of blood to the tissues. The amount of work the heart must do depends primarily on the call of the tissues all over the body for oxygen. This in turn is governed by the thyroid gland which determines the metabolic rate or the rate at which the body processes requiring oxygen go on.

When this rate has been reduced consequent on removal of the thyroid, permanent relief of the pain is achieved, but until tests show that the rate has been lowered, patients should be kept at rest in bed, in spite of the fact that they feel much better.

This permanent relief was expected to follow complete thyroid removal, but relief was experienced by the patients much sooner than expected. Dr. Blumgart and Drs. A. A. Weinstein, D. Davis and J. E. F. Riseman have spent over a year studying this aspect of the treatment. They found that the immediate relief was due to the fact that the surgeon, in removing the thyroid gland, interrupts nerve pathways which carry painful sensations from the heart to the central nervous system.

''With this early relief that occurs before the metabolic rate becomes lowered there is probably no fundamental change in the heart condition,'' Dr. Blumgart explained. ''So the importance of keeping patients in bed after the operation, in spite of their sense of well-being, until the metabolic rate falls, is to be emphasized.''

ITEMS

SUN-SPOTS, which are beginning to freckle the sun's face again after a season of relative scarcity, appear to have an intimate connection with the occurrence of sharp fluctuations in the earth's magnetic field, causing trouble with telegraphic instruments and other upsets. So A. G. McNish, of the Carnegie Institution of Washington, stated, in the course of an address before the annual meeting of the American Geophysical Union. ''When sun-spots are most numerous, magnetic storms occur most frequently,'' he said. ''The storms temporarily change the earth's magnetism. After the storms are over, the earth's magnetism returns to its original condition, for which reason it is not possible to attribute the gradual long-time changes to the action of the sun.'' There appears to be some relation between sun-spots and the aurora borealis, and in turn between these dancing northern lights and the electric currents that flow through the earth. W. J. Rooney, also of the Carnegie Institution, discussed these phenomena. The most brillian auroral displays are ordinarily accompanied by the strongest electrical effects. At such times the currents are noted at observatories far to the south of the Arctic regions, and even on the magnetic equator itself.

RAIN brings down radium, washing it out of the air, G. R. Wait and A. G. McNish, of the Carnegie Institution of Washington, told members of the American Physical Society. But you need not go out with a bucket the next time it rains, for the quantity is exceedingly minute—to be measured only with delicate instruments that tell of the electrified or ionized state of the air. With such an instrument in the open near their laboratory, it was found that as the rain began the ionization of the air increased rapidly, to fall off again when it stopped. The decrease with time was of such a character, they said, ''as to be explainable by assuming that decay-products of radium, principally radium B and radium C in equilibrium with it, are carried to the earth's surface by the rain.

BEFORE the meeting of the American Meteorological Society, J. B. Kincer, of the U. S. Weather Bureau, cast strong doubt on the hopes entertained by some of his fellow investigators that long-range weather forecasting may be made possible on the basis of cyclical or recurrent changes, possibly connected with sun-spot cycles. The Weather Bureau has made careful and open-minded tests of these methods, he said, but the results were ''keenly disappointing. The matter is still being given consideration,'' he continued, ''and claims made by persons not associated with the bureau are carefully and openmindedly investigated, but so far with no promise of success.''

THE life span of cut flowers can be lengthened by keeping them in copper containers. This is the discovery reported by John Ratsek, floriculturist on the staff of the New York State College of Agriculture. Mr. Ratsek used in his experiments containers which are copper-plated with a recently invented electro-plating finish. He found that the copper added from one to three days to the life of roses, snapdragons, stocks, delphiniums, primroses, carnations and other popular varieties of cut flowers. In one test, poinsettias in the copper container lasted sixteen days, as compared to eight days for poinsettias in a tin container. In accounting for the copper having this effect, Mr. Ratsek explained that tests showed some of the copper from the plated containers dissolved in the water. The copper thus kept the water purer by hindering growth of bacteria and other organisms which cause flowers to decay.

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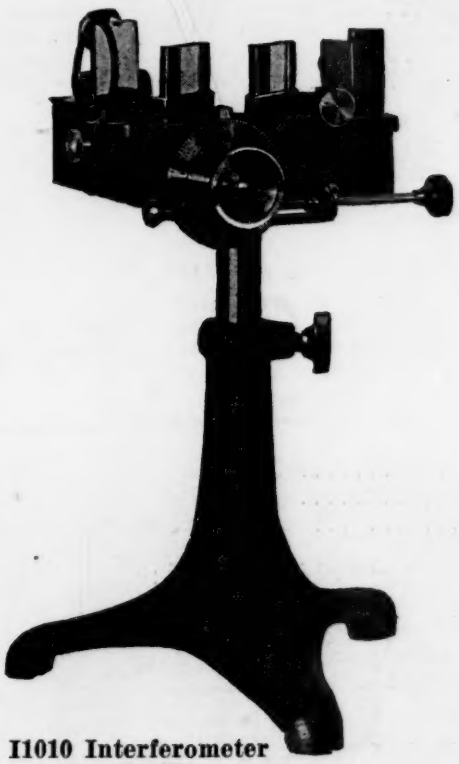

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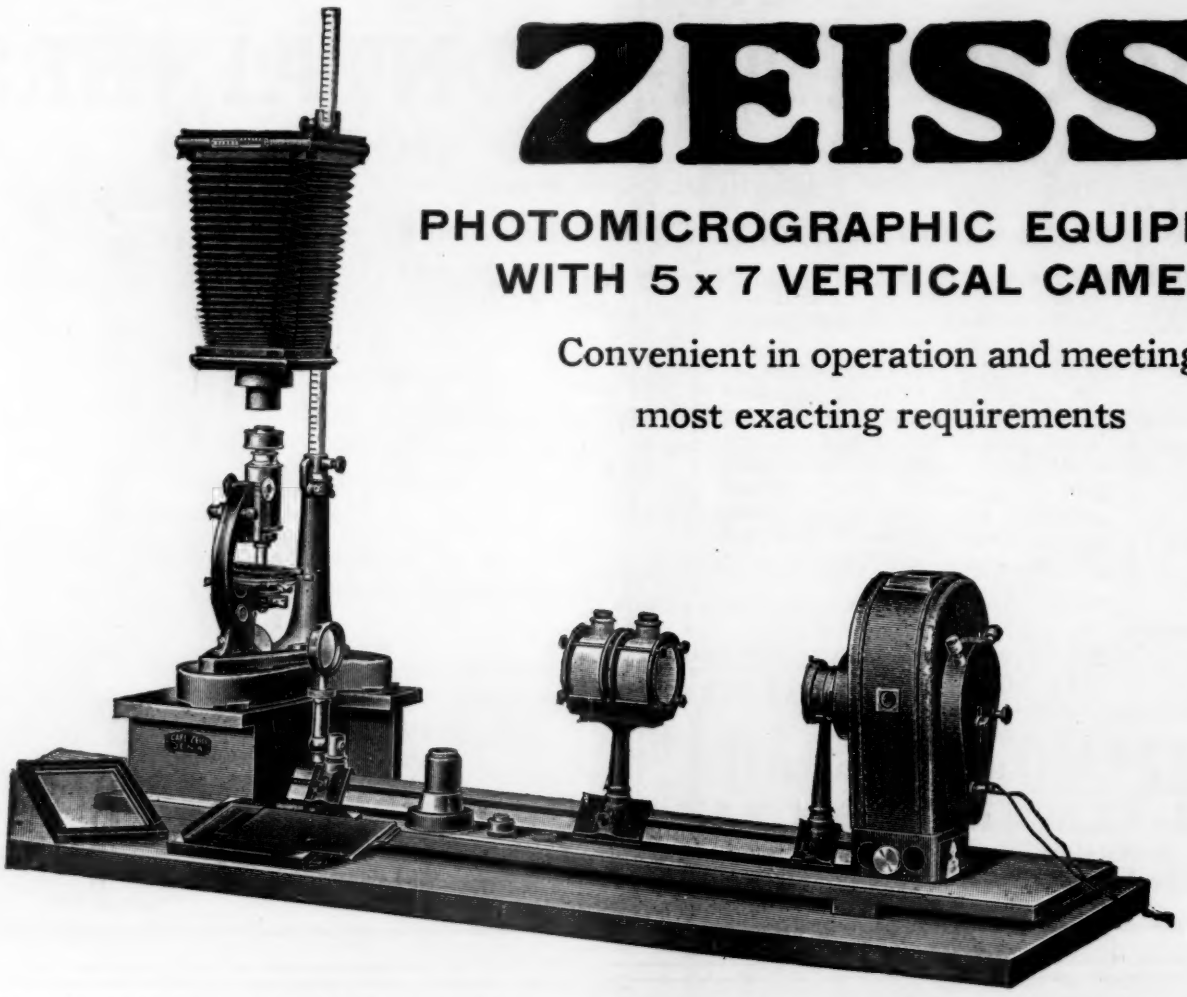

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